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PHYSICS ABSTRACTS

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Physics Abstracts

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PHYSICS ABSTRACTS

Volume 60 MAY 1957 Number 713

MATHEMATICS 51

517.392

3891. ON THE NUMERICAL CALCULATION OF CONTINUOUS INTEGRALS. I.M.Gel'fand and N.N.Cherntsov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1106-7 (1956). In Russian.

Continuous integrals are expressed as Stieltjes integrals of sufficiently high multiplicity. An example is given in which a continuous integral is replaced by 190- and 280-fold integrals, summed (or calculated) by a Monte Carlo method. G.A.Chisnall

517.433

3892. SOLUTION OF CAUCHY'S PROBLEM FOR SOME OPERATORS IN MATHEMATICAL PHYSICS. H.G.Garnir and M.Thyssen.
Bull. Soc. Roy. Sci. Liège, Vol. 25, No. 1, 27-49 (Jan., 1956). In French.

The problem investigated is that of finding, for a given operator, a distribution which satisfies a particular condition given in the paper. For an operator (A) all known formulae are obtained, while for operator (B) only certain special cases are solved. The treatment covers n-dimensional Euclidean space. Operators (A) and (B) are defined in previous papers: Garnir, Bull. Soc. Roy. Sci. Liège, No. 3, 174-94; No. 4, 271-96 (1951); Thyssen, Archives originales du Centre National de la Recherche Scientifique, No. 353, 1-30 (1954). N.Corcoran

517.5

3893. ORTHOGONALIZATION PROCEDURES AND THE LOCALIZATION OF WANNIER FUNCTIONS. B.C.Carlson and J.M.Keller.
Phys. Rev., Vol. 105, No. 1, 102-3 (Jan. 1, 1957).

The method of "symmetric orthonormalization" is shown to have a least-squares property: it constructs those unique orthonormal functions which minimize the sum of squared distances (in Hilbert space) between each initial function and a corresponding function of the orthonormal set. The localization of Wannier functions is a consequence of this property, since they can be obtained from localized atomic orbitals by symmetric orthonormalization. The theorem further implies an optimal resemblance of Wannier functions to atomic orbitals. A.

517.5

3894. THE DIRAC DELTA FUNCTION. P.A.Clavier; R.A.Johnson; R.B.Lackey.
Proc. Inst. Radio Engrs, Vol. 44, No. 12, 1876-7 (Dec., 1956).

Two letters to the editor concerning the content of a paper by Johnson (Abstr. 1839/1957). Clavier proposes the use of the theory of distributions to develop the theory of the delta functions; Lackey proposes the use of the two-sided Laplace integral. L.S.Goddard

518.5 : 548.735.44

3895. COMPUTING MACHINE FOR FOURIER'S SYNTHESIS. A.Línek.
Czech. J. Phys., Vol. 6, No. 5, 514-24 (Oct., 1956). In Russian.

One of the main tasks in solving crystal structures is the calculation of the Fourier series which gives the density of the electrons in the crystal lattice. The paper describes a relay computing machine which works out the relation

$$\rho(x) = \sum_{h=0}^{15} A_h \cos 2\pi hx + \sum_{h=1}^{15} B_h \sin 2\pi hx.$$

The machine is made up of currently produced and obtainable parts, i.e. relays, uniselector switches, and adding and printing units. The machine is designed for the following ranges of constants and data: A_h/B_h positive and negative from 0 to 1024, h from 0 to 15, division of the cell 1/120, 1/60 or 1/40 of the circumference of the circle. The calculations can also be carried out in the neighbourhood of the maxima of function $\rho(x)$ and if necessary restricted to some quadrants. A.

519.217

3896. THE CONDITION OF REGULARITY IN SIMPLE MARKOV CHAINS. J.Gani.
Austral. J. Phys., Vol. 9, No. 3, 387-93 (Sept., 1956).

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.61

3897. CONTINUOUS-BALANCE PHOTOELECTRIC GUIDER. R.H.Weitbrecht.
Rev. sci. Instrum., Vol. 28, No. 2, 122-4 (Feb., 1957).

A photoelectric guider system used in connection with a star camera on an $18\frac{1}{2}$ inch refractor is described. The guider uses a pyramid with four phototubes to determine the error-signals in both coordinates. Commercially available servomotors mounted on the double-slide plate-holder receive these signals and adjust the plate carriage to achieve a "central balance-point" upon the guide-star. The guiding action is continuous and operates on stars down to the 8th magnitude. A.

522.615

3898. ON THE APPLICATION OF THE PHOTOMULTIPLIER TO ASTRONOMICAL PHOTOMETRY. R.H.Hardie.
"Vistas in Astronomy", Volume I, 498-504. See Abstr. 10 (1957).

522.615

3899. THE DEVELOPMENT OF PHOTO-ELECTRIC PHOTOMETRY. C.M.Huffer.
"Vistas in Astronomy", Volume I, 491-8. See Abstr. 10 (1957).

A critical survey of the developments and trends of astronomical research with photoelectric methods. The eclipsing binary RZ Cassiopeia, observed by the author in two colours, serves as an illustration, leading to one of the most accurate set of elements ever obtained. The importance of multicolour photometry is emphasized. A.Beer

523.11

3900. DYNAMO THEORIES OF COSMIC MAGNETIC FIELDS. T.G.Cowling.
"Vistas in Astronomy", Volume I, 313-22. See Abstr. 10 (1957).

The development of the dynamo theory of cosmic magnetic fields during the last twenty years is critically surveyed. After a general introduction to the theory, separate sections are devoted to the steady-state theory and the theory of turbulent magnetic fields. The problems raised but not answered by earlier work are generally examined, and the important questions needing a decisive answer are enumerated. A.Beer

523.11

3901. A NOTE ON THE EXACT EXPLICIT SOLUTION OF TRANSFER EQUATIONS IN THE MILNE–EDDINGTON MODEL BY THE METHOD OF LAPLACE-TRANSFORMS. S.R.Dasgupta.
Sci. and Culture, Vol. 22, No. 3, 177-80 (Sept., 1956).

523.161

3902. INTERSTELLAR DUST. G.Alter.
"Vistas in Astronomy", Volume II, 1074-80. See Abstr. 10 (1957).

The difference between the total and selective absorption of light by interstellar dust depends on the size of the absorbing particles. The mean value of the photographic absorption-coefficient in the Galaxy is 0.84, and that of the selective absorption 0.24 magnitudes. It is indicated that in the galactic anti-centre region the metallic and carbon particles are more abundant than in the central region, where non-metallic matter and smaller particles prevail. Suggestions are made for future stellar-statistical research.

A.Beer

523.164 : 522.62

3903. THE EFFECTS OF INCOMPLETE RESOLUTION ON SURFACE DISTRIBUTIONS DERIVED FROM STRIP-SCANNING OBSERVATIONS, WITH PARTICULAR REFERENCE TO AN APPLICATION IN RADIO ASTRONOMY. S.F.Smerd and J.P.Wild.
Phil. Mag. (Eighth Ser.), Vol. 2, 119-30 (Jan., 1957).

A surface distribution can be measured by scanning in a number of directions with an observing instrument that has high resolution in only one direction. O'Brien has described a method which can be extended to reconstitute a two-dimensional distribution from a number of such "strip scans". Because of the finite width of the strip and the associated lack of resolution, the "derived" distribution differs, in general, from the "true" distribution. But, because this method of measuring a two-dimensional distribution is indirect and complex, the exact form such deviations may take is not apparent. It is shown that the derived distribution is identical with that which would be recorded directly by two-dimensional scanning with a particular "spot"-instrument; the power response of this equivalent "spot" has radial symmetry and is such that a line scan of it along any diameter is the same as the power response of the "strip" in the direction of high resolution. An application of this to the determination of two-dimensional distributions of radio brightness over the sun's disc is discussed. A.

523.164 : 621.396.62

3904. A SPECTROMETER FOR THE 20 CM RANGE WITH EXTREMELY HIGH RESOLUTION AND SENSITIVITY. K.W.Grimm.
Telefunken Ztg, Vol. 29, 191-8 (Sept., 1956). In German.

A description of the measuring equipment for the Bonn University radio telescope. The following features are discussed; sensitivity, frequency measurement and its accuracy, resolution and standardization, amplification and demodulation, and screening from interference. M.W.Ovenden

523.164.32

3905. OUTBURSTS OF RADIO NOISE FROM THE SUN. J.P.Wild.
"Vistas in Astronomy", Volume I, 573-84. See Abstr. 10 (1957).

Occasional large increases ("outbursts") of radiofrequency radiation from the sun have been detected on frequencies ranging from 9-35 000 Mc/s. They last for several minutes and show a big correlation with solar flares. Recent investigations of their spectrum and position on the solar disk have indicated an origin in corpuscular streams ejected from flares. Current evidence suggests that the intense radio-waves are excited at harmonics of the plasma frequency during the passage of the streams through the corona.

A.Beer

523.164.42

3906. THE SCINTILLATION OF RADIO STARS. A.Hewish.
"Vistas in Astronomy", Volume I, 599-606. See Abstr. 10 (1957).

Experiments are described which show that the scintillation is caused by diffraction of the incoming waves by irregularities of electron density in the upper ionosphere. The origin of the irregularities is not known and the solution may raise problems of astronomical interest. A phenomenon similar to scintillation occurs when a radio source is viewed through the solar corona; this enables deductions to be made about the irregular structure of the corona at distances in the range 5-15 solar radii. A.Beer

523.164.43

3907. MEASURES OF THE 21 cm LINE EMITTED BY INTERSTELLAR HYDROGEN. J.H.Oort.
"Vistas in Astronomy", Volume I, 607-16. See Abstr. 10 (1957).

The observations of the radiation at 21.1 cm wavelength, emitted by interstellar hydrogen, are discussed. These observations, made mostly by Muller in the Netherlands and discussed by van de Hulst, Muller and Oort, show that the interstellar clouds are confined to spiral arms that can be traced to distances that were inaccessible to investigations at the wavelengths of light. From these observations also the velocity of rotation of the galactic system at different distances from the galactic centre can be determined, as well as the distance of the sun from the centre. The temperature of the interstellar clouds is estimated to be about 100°, and their average density in the galactic plane to be about 0.9 hydrogen atoms per cubic centimetre. A.Beer

523.164.85

3908. RADIO-ECHO STUDIES OF METEORS. J.G.Davies and A.C.B.Lovell.
"Vistas in Astronomy", Volume I, 585-98. See Abstr. 10 (1957).

The radio-echo techniques relevant to meteor astronomy are described, such as methods for the determination of radiants and velocities. The discovery of the series of day-time meteor streams is given as an illustration of the ability of these methods to work under conditions when photographic and visual observations are impossible. The work on the intersellar meteor problem relating to the origin of the sporadic meteors is outlined, as well as the use of radio techniques in meteor physics. A.Beer

523.6

3909. ON THE SECULAR ACCELERATION AND RETARDATION OF THE MOTION OF SHORT-PERIOD COMETS. D.O.Mokhnach.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 1, 50-3 (1956). In Russian.

Certain discrepancies between the observed and calculated values of the coordinates of short-period comets have been explained in the past by postulating a secular acceleration or retardation. Previous work of the author's (Byulleten' I.T.A. Akademii Nauk S.S.S.R., Vol. 6, No. 5, 78, 1956) has shown that the non-coincidence of the photometric centre and the centre of inertia of the head of a comet leads to systematic errors in the observational determination of the coordinates of the centre of inertia. An example is given which shows that, using pre-perihelion observations, such errors lead to an apparent secular acceleration of the comet, whilst using post-perihelion observations, an apparent secular retardation is obtained. The effect (of a secular acceleration or retardation) can be created almost entirely by systematic errors in the observations. Other evidence is given to show that such errors can also account for other discrepancies in the observations. G.A.Chisnall

523.7

3910. SPECTROSCOPIC MEASUREMENTS OF MAGNETIC FIELDS ON THE SUN. H.von Klüber.
"Vistas in Astronomy", Volume I, 751-76. See Abstr. 10 (1957).

The various methods employed for the measurement of solar magnetic fields, on the basis of the Zeeman effect in the Fraunhofer spectrum, are described. The optical arrangements are discussed and illustrated. A short examination is made of the results obtained for the field strength in sunspots, and of the problem of the general magnetic field of the sun. A.

523.72

3911. THE CORPUSCULAR RADIATION OF THE SUN. M.J.Smyth.
"Vistas in Astronomy", Volume II, 813-20. See Abstr. 10 (1957).

The evidence for radiation of charged particles from the sun as a source of solar–terrestrial relationships is examined. Theories of magnetic storms and aurorae and the occurence of flare storms and M-storms are discussed, as well as the connection of solar corpuscles and aurorae, and the possibilities and lines of future investigations. A.Beer

523.746

3912. THE MAGNETIC FIELD OF SUNSPOTS. E.C.Bullard.
"Vistas in Astronomy", Volume I, 685-91. See Abstr. 10 (1957).

The occurence of sunspots in pairs with opposite magnetic polarities can be explained if it is assumed that lines of magnetic force encircle the axis of rotation in opposite directions a little below the surface of the sun. Material moving upwards will carry a loop of field through the surface and give a south magnetic pole on the same circle of latitude. Such a field is to be expected from the interaction of the sun's non-uniform rotation with a meridional field. The progression of the spots in latitude requires a slow meridional circulation. The dynamics of the non-uniform rotation and the meridional circulation are not understood; it is possible that the equatorial parts of the sun are coupled magnetically to a more rapidly rotating interior. A.Beer

523.746

3913. OBSERVATIONS OF SUNSPOTS IN 1955. F.Yilmaz.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 21, No. 2, 110-17 (April, 1956). In French.

A continuation of previously published annual summaries. The sun was observed on 299 days, and 221 spot groups were recorded. D.R.Barber

523.75

3914. SOLAR FLARES. M.A.Ellison.
"Vistas in Astronomy", Volume II, 799-807. See Abstr. 10 (1957).

Critical survey of recent work on the general properties of solar flares, their spectra, and ionospheric effects. The author's work on particle emissions, as well as radio emissions due to flares, and theoretical considerations are illustrated. A.Beer

523.752

3915. THE EXCITATION TEMPERATURE OF THE SOLAR CHROMOSPHERE DETERMINED FROM MOLECULAR SPECTRA. D.E.Blackwell.
"Vistas in Astronomy", Vol. I, 726-32. See Abstr. 10 (1957).

The excitation temperature of the solar chromosphere is derived from a study of the rotational structure of the 4216 A system of CN and the P- and R-branches of the (0,0) band of the $^2\Delta-^2\Pi$ system of CH. The temperatures are 5400°, 7400° and 5100°. A.

523.752

3916. AN UNUSUAL SPECTROGRAM OF A PROMINENCE TAKEN WITH THE CORONAGRAPH. H.Haupt.
S.B.Österr. Akad. Wiss. IIa, Vol. 164, No. 5-7, 267-71 (1955). In German.

In the spectrum of a prominence photographed at Kanselhöhe Observatory on 11 Sept. 1948, no fewer than 22 emission lines of Mg, Cr, Ti, Sc, and Fe were found in the region, 5160 A to 5530 A. D.R.Barber

523.755

3917. RAPID TEMPORAL FLUCTUATIONS OF THE MONOCHROMATIC GREEN CORONA. M.Gentili di Giuseppe and M.Trellis.
C.R.Acad. Sci. (Paris), Vol. 243, No. 22, 1724-6 (Nov. 26, 1956). In French.

Stresses the importance of the time factor in interpreting day-to-day fluctuations of the coronal radiation at 5303 A; a variation caused partly by the rotation of the sun, and in part also by real changes in the corona itself. D.R.Barber

523.77 : 523.87

3918. ATOMIC SPECTRA - THEIR ROLE IN ASTROPHYSICS. C.E.Moore.
"Vistas in Astronomy", Volume II, 1209-22. See Abstr. 10 (1957).

The use of atomic spectra as a connecting link between stars and atoms is illustrated by the spectrum of the sun. The importance of multiplets found from the analyses of laboratory spectra in the identification of solar lines is exemplified by selected lines of P I, S I, Si I, Mg I, and Fe I. Solar lines identified from predicted wavelengths, calculated from the energy levels, are found among these spectra. The elements represented in the sun only in compounds or by only one atomic line are discussed in some detail. The idea of a second revision of Rowland's Table of the Solar Spectrum Wavelengths, including measured equivalent widths and revised identifications, which is now contemplated, is outlined. A.Beer

523.77

3919. VARIATION, FROM THE CENTRE TO THE LIMB OF THE SUN, OF THE PROFILE OF THE SPECTRA LINE λ = 4227 OF Ca I. I-II. T.Fortini and G.Caprioli.
R.C. Accad. Naz. Lincei, Vol. 20, No. 5, 610-16 (May); No. 6, 773-7 (June, 1956). In Italian.

523.774

3920. OBSERVATIONS ON ENERGY DISTRIBUTION IN ABSOLUTE UNITS OF THE CONTINUOUS SPECTRUM IN THE CENTRE OF THE SOLAR DISK. G.F.Sitnik.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 2, 193-6 (1956). In Russian.

These were carried out using (a) a silver sulphide photoelectric cell with an enclosed layer, with a galvanometer, for the region 5300-12 500 A; (b) a photomultiplier with an antimony–caesium cathode in combination with an electronic oscillograph, for 3500-6200 A. A graph of the results compares them with those of Abbott and others. T.W.Olle

523.821

3921. THE CAPE MAGNITUDES AND THEIR RELATIONSHIP TO THE INTERNATIONAL SYSTEM. R.H.Stoy.
"Vistas in Astronomy", Volume II, 1099-111. See Abstr. 10 (1957).

The origin of the Cape 1953S-system of standard stellar magnitudes is discussed: the available links of this system with the International System and with the U-B-V system of Johnson and Morgan are examined and best-fitting linear relationships are derived. The inadequacy of the North Polar Sequence to serve as the final standard for modern astronomical photometry is emphasized and some possible alternatives are pointed out. A.Beer

523.823

3922. ON A POSSIBLE IMPROVEMENT OF MICHELSON'S METHOD FOR THE DETERMINATION OF STELLAR DIAMETERS IN POOR VISIBILITY. R.Fürth and E.Finlay-Freundlich.
"Vistas in Astronomy", Volume I, 395-405. See Abstr. 10 (1957).

New experimental material is presented in support of a previously proposed improvement of Michelson's interferometric method for the determination of stellar diameters, which consists in the production of a "secondary" (extrafocal) fringe pattern. It is claimed that this method is less affected by atmospheric disturbances than the original one. This might make it possible, on the basis of a theorem by Emil Wolf, to determine the light-intensity distribution over the surface of a star from interferometric measurements, even under poor seeing conditions. A.Beer

523.841

3923. A CONTRIBUTION TO THE PROBLEM OF THE CLASSIFICATION OF VARIABLE STARS. L.Gratton.
"Vistas in Astronomy", Volume II, 1132-42. See Abstr. 10 (1957).

The importance of a successful classification of variable stars is examined and the following criteria are suggested as the most useful for this purpose: (1) light variations; (2) spectrum; (3) position in the Hertzsprung–Russell diagram; (4) statistical properties in the galactic system; (5) theoretical interpretation of the variability, as far as possible today. The new scheme of classification proposed is based on these criteria and aims at modifying as little as possible the existing classes. Four main groups are distinguished; each of them incorporates several classes and subclasses. The hope is expressed that this scheme might help to clarify the general phenomenon of stellar variability. A.Beer

523.841.11 : 539.163

3924. SUPERNOVAE AND CALIFORNIUM 254.
W.Baade, G.R.Burbidge, F.Hoyle, E.M.Burbidge, R.F.Christy and W.A.Fowler.
Publ. Astron. Soc. Pacific, Vol. 68, 296-300 (Aug., 1956).

The linear decrease in the light curves of type I supernovae, which sets in about 100 days after maximum brightness, is explained as an effect of the decay of a radioactive source with halflife of 55 ± 1 day. The isotope responsible is identified with the transuranic element, Cf^{254} recently reported by Fields et al. (1956). D.R.Barber

523.852

3925. ON THE FORMATION OF CONDENSATIONS IN A GASEOUS NEBULA. H.Zanstra.
"Vistas in Astronomy", Volume I, 256-68. See Abstr. 10 (1957).

In order to get an insight into the process of formation of condensations in an ionized gas of high kinetic temperature, two main principles are applied: (1) that the pressure in the less dense medium should be about the same as in the denser medium, which means that in the denser medium the kinetic or electron temperature is correspondingly lowered; (2) that this lowering is brought about by electron impacts exciting low level lines. The approximate balancing of pressure is verified in the case of prominences considered as condensations in the solar corona. In order to account for condensations observed by Baade in the planetary nebula NGC 7293 in Aquarius, a very simplified model of a nebula is worked out, consisting of one substance only, occurring as ions A^+ and "atoms" A, the latter having a low metastable level, while the ionization of A into A^+ is fairly complete. Introducing the liberation temperature corresponding to the average of the photoelectrons when freed from A, it is shown that separation into two phases will occur above a certain critical liberation temperature of about 50 000°. For about 110 000°, or stellar temperature 170 000°, the volumes per unit mass in the two phases are in the ratio 15:1, while the electron temperatures are 130 000° and 9 000°, the latter being about the value derived in regions of planetary nebulae where forbidden lines are excited. Similar results can be expected for a nebula consisting of hydrogen with the substances A and A^+ intermixed. It is suggested that the cometary shape of many of the condensations observed in NGC 7293 might be due to aggregates of matter already present in interstellar space, serving as nuclei for condensation, the conspicuous comet-like tails being formed by dragging along of matter by the outward moving gases of the nebula. A.Beer

523.854

3926. SPECTROSCOPIC INDICATIONS OF AN INTERNAL SPIRAL ARM IN THE GALAXY. A.D.Thackeray.
Nature (London), Vol. 178, 1458 (Dec. 29, 1956).

Certain southern B stars with distances probably greater than 3 kparsecs were studied at a dispersion of 19 A/mm at 3933 A to detect possible resolution of the interstellar K-line due to differ-

ential galactic rotation in spiral arms. Three stars (H.D. 142, 468; 142, 565; 173, 987) have well-separated K-lines; two stars (H.D. 147,331; 148,546) have a separation of the order of 25 km/s and four others (H.D. 114, 340; 122, 324; 125,241; 136, 239) show no doubling. $\Delta\omega(R)$ is determined from the first three stars. The observations indicate that $\Delta\omega(R)$ is greater at longitude 295° than at 355°, for the interior (Scutum-Norma) arm corresponding to the high-velocity component of the K-lines. G.A.Chisnall

523.877

3927. ENERGY PRODUCTION IN STARS. E.E.Salpeter.
"Vistas in Astronomy", Volume I, 283-90. See Abstr. 10 (1957).

Current ideas in the field of stellar energy production are discussed, in particular thermo-nuclear reactions. A list is given of those reactions which might be important in the interior of different types of stars, together with the temperature at which these reactions set in. It is shown that the proton—proton chain almost certainly is the source of energy of the sun and of cooler main sequence stars, and the carbon-nitrogen cycle most probably the energy source for the hotter main sequence stars of spectral types A, B, and O. New evolutionary ideas, particularly connected with subgiants in globular clusters, are outlined. A.Beer

523.877

3928. ON THE INTERPRETATION OF STELLAR MAGNETIC FIELDS. S.K.Runcorn.
"Vistas in Astronomy", Volume I, 323-30. See Abstr. 10 (1957).

The large variation of stellar magnetic fields with time in many stars presents a difficulty, the explanation of which in terms of mechanical oscillations is not satisfactory. This paper is a new attempt to examine under what conditions the measurements can be reconciled with the assumption of a steady field. This "oblique rotator" theory can only be true if the fields contain strong multipole components, and a suggestion is made as to why this is probable. In addition, certain elements must be concentrated in certain areas of the stellar surface to account for the intensity- and Doppler-displacement variation observed for certain spectral lines. A.Beer

523.877

3929. "TURBULENCE", KINETIC TEMPERATURE, AND ELECTRON TEMPERATURE IN STELLAR ATMOSPHERES.
P.L.Bhatnagar, M.Krook, D.H.Menzel and R.N.Thomas.
"Vistas in Astronomy", Volume I, 296-303. See Abstr. 10 (1957).

The phenomenological use of the term "astronomical turbulence" is reviewed and earlier conclusions that the physical nature of the phenomenon is more likely anisotropic mass-motion, or jet-prominences, than the customary aerodynamic turbulence are restated. The primary problem under such conditions is the relative importance of mechanical energy-transport and momentum transport in perturbing the structure of the atmosphere. The problem of the difference between kinetic temperatures of the atoms and electrons is treated, and it is concluded that the difference in negligible in those parts of the stellar atmosphere which are in a statistically-steady state. A.Beer

525.3

3931. OPTICAL PROBLEMS OF THE SATELLITE. R.Tousey.
J. Opt. Soc. Amer., Vol. 47, No. 4, 261-7 (April, 1957).

Some of the optical problems connected with an artificial earth satellite are: visibility, the photographic determination of the precise orbit, and the temperature that the satellite will reach through radiation exchange. These matters are discussed with particular reference to the plans for the satellites to be launched by the United States during the International Geophysical Year. One of the first experiments to be flown will be the monitoring of the Lyman-alpha-line radiation of hydrogen emitted by the sun and the measurement of intensity variations associated with solar flares. A.

523.877

3930. THE PROBLEM OF STELLAR TEMPERATURES.
H.Kienle.
"Vistas in Astronomy", Volume II, 1321-7. See Abstr. 10 (1957).

The problem of the determination of stellar colour temperatures by comparing the intensity distribution in the continuous spectrum with the radiation of terrestrial light-sources of known intensity distribution is freshly examined. The newly developed xenon high-pressure lamps seem to offer a convenient source, having a colour temperature close to that of the sun. A.Beer

529.7

3932. RELATION BETWEEN THE PROPER TIME OF A TERRESTRIAL CLOCK AND THE ASTRONOMICAL SCHWARZSCHILD TIME TO THE 10^{-12} APPROXIMATION.
O.Costa de Beauregard.
J. Phys. Radium, Vol. 18, No. 1, 17-21 (Jan., 1957). In French.

To the 10^{-12} approximation, a clock located on the earth's surface is slow when referred to a similar one at rest in the solar system and infinitely distant from the sun. There are four causes of the phenomenon: mass of the sun, circulation of the earth around the sun, mass and rotation of the earth. The corresponding effects are calculated here without reference to the influence of the moon: qualitative arguments show that this influence is negligible to the aforesaid approximation; a rigorous theory of the moon's effects would involve a two body relativistic theory. A.

PHYSICS 53

53

3933. REPORT FROM THE CONFERENCE OF THE SWEDISH NATIONAL COMMITTEE FOR PHYSICS IN 1955. G.Borelius and E.Rudberg.
Ark. Fys., Vol. 11, Paper 5, 101-35 (1956).

Short summaries of the papers presented at the Conference (September, 1955) are given in this communication.

53

3934. ON THE USE OF PSEUDO-TENSORS IN PHYSICS.
T.Vogel.
J. Phys. Radium, Vol. 18, No. 2, 81-4 (Feb., 1957). In French.

Most physicists make use, in addition to true tensors, of other geometrical concepts, such as axial vectors, tensor capacities and tensor densities, governed by special transformation rules. The author is opposed to the use of these for reasons which are stated. A.

FUNDAMENTALS 530.1

530.12 : 531.31

3935. VARIATIONAL PRINCIPLE AND POTENTIAL IN RELATIVISTIC DYNAMICS. G.Szamosi.
Acta phys. Hungar., Vol. 6, No. 2, 207-15 (1956).

This paper gives a very simple canonical formulation of the relativistic dynamics of the mass point, making use of the fact that the four equations of motion determine not only the three independent components of the four-velocity, but the rest mass too. For the determination of these four unknowns there are four equations, the Lagrange function of which can be put into covariant form. By the aid of the method described in the present paper the equations of motion can be derived from a Lagrange function of general type even for such cases, where up to now only ad hoc solutions have been found. The relativistic equivalent of the classical potential can be interpreted generally. The absolute value of the relativistic potential is bounded for the case where it does not depend on the velocity. The relativistic wave-equations can be derived from the classical relations in a way analogous to the non-relativistic case. The rest mass and the proper time are non-commutative quantities. A.

530.12

3936. ON THE USE OF ISOTHERMAL COORDINATES TO DETERMINE THE EQUATIONS OF MOTION IN GENERAL RELATIVITY. Pham Tan Hoang.
C.R. Acad.Sci.(Paris), Vol. 243, No. 18, 1292-5 (Oct. 29, 1956). In French.

Calculations are given for the two-body problem and the equations of motion obtained differ from those derived by the Einstein—Infeld—Hoffman method. It is concluded that the equations of motion in general relativity are not independent of coordinate conditions. R.A.Newing

530.12 : 530.162

3937. POSSIBLE REPRESENTATION OF THE THEORY OF PROBABILITY IN RELATIVISTIC SPACE-TIME (CASE OF A SINGLE RANDOM POINT). P.Leruste.

C.R. Acad. Sci. (Paris), Vol. 243, No. 15, 1021-2 (Oct. 8, 1956). In French.

The 3-space probability density f is replaced by a 4-vector current density f_μ which satisfies the conservation law $\partial^\mu f_\mu = 0$. R.A.Newing

530.12 : 530.162

3938. POSSIBLE INTRODUCTION TO A STATISTICAL MECHANICS OF THE RELATIVISTIC RANDOM POINT. P.Leruste.
C.R. Acad. Sci. (Paris), Vol. 243, No. 16, 1102-5 (Oct. 15, 1956). In French.

The position and momentum 4-vectors in Minkowski space-time define an 8-dimensional phase space, and their proper time derivatives define a conservative 8-vector field U_ρ. The constancy of the flux of U_ρ along a tube in phase space provides an analogue of Liouville's theorem. R.A.Newing

530.12 : 532.5

3939. INTRODUCTION OF THE SPIN VECTOR IN THE WEYSSENHOFF FLUID. F.Halbwachs.
C.R. Acad. Sci. (Paris), Vol. 243, No. 15, 1022-4 (Oct. 8, 1956). In French.

The spin vector σ_μ is defined to be $(1/c)\bar{s}_{\mu\nu}\, u^\nu$, where $\bar{s}_{\mu\nu}$ is the dual of the Weyssenhoff spin tensor and u^ν is the 4-vector fluid velocity. σ_μ is shown to be orthogonal to the 4-vector acceleration, and to be constant for any given fluid particle. R.A.Newing

530.12 : 532.5

3940. NEW REPRESENTATION OF THE RELATIVISTIC FLUID WITH SPIN. F.Halbwachs.
C.R. Acad. Sci. (Paris), Vol. 243, No. 16, 1098-100 (Oct. 15, 1956). In French.

The equations of motion for a fluid with intrinsic spin are expressed in terms of the spin 4-vector σ_μ (see preceding abstract) and the "proper space momentum" $p^\mu = m_0 u^\mu - g^\mu$, where m_0 is the proper mass density and g^μ the Weyssenhoff momentum density. The vectors σ_μ and p^μ, together with the current density and acceleration 4-vectors, form an orthogonal set of vector fields. R.A.Newing

530.12 : 531.51 : 538.3

3941. NONLINEARITY AND CONFORMAL RECIPROCITY. A.Popovich.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 1, 74-7 (1956). In Russian.

By exploiting several points of analogy between the gravitational and Maxwellian fields a conformal reciprocity is established between the nonlinear field equations of curved space—time and those of a unitary electromagnetic field theory, such as that of Born and Infeld (Proc. Roy. Soc. A, Vol. 144, 425, 1934). J.W.Gardner

530.12

3942. ON THE EQUATIONS OF MOTION IN UNIFIED FIELD THEORY. Pham Tan Hoang.
J. Phys. Radium, Vol. 18, No. 1, 27-32 (Jan., 1957). In French.

In the Einstein–Schrödinger unified field-theory, the Einstein–Infeld--Hoffman method gives only the equations of motion of uncharged particles. This result was obtained to a 4th-order approximation, by admitting that the antisymmetric part of Ricci tensor $R_{\alpha\delta}$ does not contribute. The field equations are developed to a higher approximation, so as to examine subsequently if the electromagnetic field effect is still suppressed and to make evident the possible influence of $R_{\alpha\delta}$. A.

530.12

3943. ON SOME SPHERICALLY SYMMETRICAL MODELS IN RELATIVITY. R.V.Wagh.
J. Univ. Bombay, Vol. 24, Pt 3, 5-9 (Nov., 1955).

A particular solution is obtained for the metric $ds^2 = dt^2 - e^\mu d\sigma^2$ where e^μ is a function of $(c^2t^2 - r^2)$ and is expressed in terms of elliptic functions. R.A.Newing

530.12

3944. INVARIANT FORMULATION OF GRAVITATIONAL RADIATION THEORY. F.A.E.Pirani.
Phys. Rev., Vol. 105, No. 3, 1089-99 (Feb. 1, 1957).

Gravitational radiation is defined invariantly within the framework of general relativity theory. The definition is arrived at by assuming (a) that gravitational radiation is characterized by the Riemann tensor, and (b) that it is propagated with the fundamental velocity. Therefore a gravitational wave-front should appear as a discontinuity in the Riemann tensor across a null 3-surface; the possible form of this discontinuity is here calculated from Lichnerowicz's continuity conditions. The concept of an observer who follows the gravitational field is defined in terms of the eigenbivectors of the Riemann tensor. It is shown that the 4-velocity of this observer is timelike for one of Petrov's three cononical types of Riemann tensor, but null for the other two types. The first type is identified with the absence of radiation, the other two with its presence. This constitutes the definition. It is shown that the difference between the no-radiation type and one of the radiation types can be made to correspond to the discontinuity possible across a null 3-surface; this demonstrates the consistency of the wave front and following-the-field concepts. A convariant approximation to the canonical energy-momentum pseudo-tensor is defined, using normal coordinates, which are given a physical interpretation. It is shown that when gravitational radiation is present, the approximate gravitational energy-flux cannot be removed by a local Lorentz transformation, which supports the definition of radiation. It is proved that, as would be demanded of a sensible definition, there can be no gravitational radiation present in a region of empty space-time where the metric is static. A.

530.12

3945. VARIATIONAL CALCULATIONS IN GEON THEORY. F.J.Ernst, Jr.
Phys. Rev., Vol. 105, No. 5, 1662-4 (March 1, 1957).

Idealized spherical "geons," or gravitational-electromagnetic entities, of the type studied by Wheeler utilizing an electronic calculator, are here studied by using a simple adaptation of the Ritz variational principle. By using the simplest of trial functions, most of the relevant magnitudes are calculated with considerable accuracy. A.

530.12

3946. LINEAR AND TOROIDAL GEONS. F.J.Ernst, Jr.
Phys. Rev., Vol. 105, No. 5, 1665-70 (March 1, 1957).

It has been argued by Wheeler that the coupled equations of the electromagnetic field and the gravitational field of general relativity,

$$R_{ik} - \tfrac{1}{2}g_{ik}R = (8\pi G/c^4)T_{ik},$$

$$T_i^{\,k} = (1/4\pi)(F_{ij}F^{kj} - \tfrac{1}{4}F_{\alpha\beta}F^{\alpha\beta}\delta_i^{\,k}),$$

$$(-g)^{-1/2}(\partial/\partial x^j)(-g)^{1/2}F^{ij} = 0,$$

$$F_{ij} = A_j/\partial x^i - \partial A_i/\partial x^i,$$

should admit a set of completely singularity free solutions, A_i, g_{jk} (i, j, k = 1,2,3,4), with the following properties: (1) The gravitational mass originates solely from the energy stored in the electromagnetic field. In particular there are no material masses present. (2) No charges or currents are present, and $A_4 = 0$ everywhere. (3) The other components of the electromagnetic vector potential A_i are vanishingly small except within a toroidal region of space. Physically the electromagnetic field consists of light waves circling the torus in either direction. Such a torus of electromagnetic field energy is called a toroidal geon. An exact and detailed mathematical treatment of the general toroidal geon problem would be extremely complicated, requiring the solution of a set of coupled nonlinear partial differential equations. However, in the present paper it is shown how toroidal geons of large major radius to minor radius ratio may be studied by a simple method of approximation, providing one has a complete knowledge of the so-called linear geons, the electromagnetic field energy of which is confined to an infinitely long circular cylinder rather than to a torus. A detailed mathematical treatment of linear geons proves to be possible, as is demonstrated in this paper. The electromagnetic field potentials A_i i = (1,2,3) of a toroidal geon or of a linear geon possess the same general nature as the electromagnetic field potentials encountered in the solution of classical toroidal and cylindrical waveguide problems. In this paper the case is considered where the electromagnetic field of the linear geon is a monochromatic standing-wave vibrating in the lowest transverse-electric mode of the system. The field equations are derived from a variational principle, and these equations are solved numerically. The results are not surprising, as the general form of the unknown functions can be ascertained by quite simple considerations. These results give the foundation material for a proposed later treatment of toroidal geons. A.

530.145

3947. REMARKS ON THE THEORY OF BILOCAL FIELDS. G.Raĭskiĭ (Rayski).
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 705-6 (1956). In Russian.

Several points of the author's theory are explained, partly in answer to a criticism of Zhirnov (Abstr. 5681/1956) but the question of the introduction of interactions is still an open one. G.E.Brown

530.145

3948. CAUSALITY CONDITIONS AND PHYSICAL REALIZIBILITY CRITERIA IN QUANTUM FIELD THEORY. L.A.Khalfin.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 2, 345-7 (1956). In Swedish.

The reciprocity theorem and time-reversal (in the Wigner sense) are examined in terms of generalized quantum field theory and found to imply certain causal restrictions on the field variables, or, more precisely, their Fourier transforms. Parity conservation, however, does not appear to be a necessary concomitant of causality. J.W.Gardner

530.145

3949. CONSEQUENCES OF THE RENORMALIZABILITY OF QUANTUM ELECTRODYNAMICS AND MESON THEORY. V.V.Sudakov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 729-31 (1956). In Russian.

This formulation starts from the equations derived by Gell-Mann and Low (Abstr. 9929/1954) for the asymptotic region; the renormalization is indicated. G.E.Brown

530.145

3950. THEORY OF P-WAVE PION–NUCLEON INTERACTION. S.Fubini and W.E.Thirring.
Phys. Rev., Vol. 105, No. 4, 1382-7 (Feb. 15, 1957).

Exact relations are used to determine parameters like the cut-off and the unrenormalized coupling constant which are consistent with the low-energy scattering data. Under general assumptions about the Hamiltonian some inequalities are derived. For the Chew model those paramters can be determined with great accuracy. If one uses a Yukawa source function, the cutoff must be 4.7 and $f_0^2 = 0.22$ in order not to be inconsistent with those relations. A.

530.145

3951. NUCLEAR [GREEN] PROPAGATION FUNCTION IN QUADRATIC APPROXIMATION. V.G.Solov'ev.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 3, 578-81 (1956). In Russian.

The explicit functional integral given by Edwards (Abstr. 2415/1955) is evaluated by Fredholm methods to give the Green function as a second-degree expansion in the nucleonic momenta. J.W.Gardner

530.145

3952. THE CONCEPT OF PARTICLES IN CLASSICAL AND IN QUANTUM THEORY. D.Park.
J. Phys. Radium, Vol. 18, No. 1, 11-16 (Jan., 1957). In French.

If one assumes that all the particle properties of matter are quantum properties, arising out of the quantization of a classical wave-field, then it is found that the ordinary wave-equations of quantum mechanics may be written in a form which involves neither Planck's constant nor any particle properties, and may therefore be called entirely classical in their content. The quantization of these classical equations leads directly to the quantum-mechanical equations of motion for an n-particle system, and a discussion of the correspondence principle shows how the behaviour described by these quantized fields reduces in the classical limit to that derivable either from Newtonian mechanics or from the classical wave-equations, whichever is appropriate. A.

530.145

3953. ON THE BILOCAL THEORY OF THE ELECTRON. E.Minardi.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1127-32 (Nov., 1956). In Italian.

Previous papers (Abstr. 8031/1954, 4815/1955) have proposed a "bilocal" theory of interaction between a spin ½ particle and the quantized electromagnetic field: in such a theory the internal coordinates (η) describing the "structure" of the particle appear on an equal footing with the external coordinates (x) describing its observable motion. The interaction Hamiltonian is formulated in terms of η and x and evaluated in the zero-order approximation i.e. assuming a particle of small but non-zero mass and neglecting transitions between states of different mass. It is found in this case that the mass obtained for the particle is due entirely to emission and absorption processes involving virtual photons interacting exclusively with the η-field. Such processes have no equivalent in the x-field (local theory) limit: the mass vanishes in this approximation. J.W.Gardner

530.145

3954. SOME REMARKS ABOUT ELECTRON-CORRELATION. O.Krisement.
Phil. Mag. (Eighth Ser.), Vol. 2, 245-58 (Feb., 1957).

A comparison is made between the theories of Wigner (Phys. Rev., Vol. 46, 1002, 1934), Wigner and Seitz (Phys. Rev., Vol. 46, 509, 1934), and of Pines (Abstr. 1279/1954, 6038/1956), Bohm and Pines (Abstr. 5379/1951, 1278/1954), Pines and Bohm (Abstr. 2688/1952), which both represent different approaches to an inclusion of correlation in the wave-mechanical treatment of a free electron gas. Starting with a determinantal wave-function for the electron gas, correlation is taken into account by means of a "modulating" function by which the complete wave-function must be multiplied. It can be shown that in both theories these modulating functions are nearly the same. A more detailed consideration of Wigner's treatment gives a "cut-off" wavelength for the collective behaviour which is numerically nearly equal to the "cut-off" wavelength in the theory of Bohm and Pines. A.

530.145 : 538.114

3955. FERROMAGNETISM OF A GAS OF HARD SPHERE FERMIONS. J.B.Ehrman.
Phil. Mag. (Eighth Ser.), Vol. 2, 404-21 (March, 1957).

The energy of a gas of fermions of spin ½, interacting with a hard sphere repulsion, is obtained by means of Brueckner's approach to the many-body problem. The single-particle potential is computed in the effective mass approximation, and the value of the maximum density for which this approximation is valid, is derived. By means of a modification of the effective mass approximation, in which the effective mass becomes spin-dependent, it is shown that above a certain critical density, the gas becomes ferromagnetic. A.

530.145

3956. PARITY NONCONSERVATION AND A TWO-COMPONENT THEORY OF THE NEUTRINO. T.D.Lee and C.N.Yang.
Phys. Rev., Vol. 105, No. 5, 1671-5 (March 1, 1957).

A two-component theory of the neutrino is discussed. The theory is possible only if parity is not conserved in interactions involving the neutrino. Various experimental implications are analysed. Some general remarks concerning nonconservation are made. A.

530.145

3957. THE BEHAVIOUR OF PARTICLES WITH SPIN IN CROSSED CONSTANT AND VARYING MAGNETIC FIELDS. A.I.Rivin.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 733-4 (1956). In Russian.

An exact solution of this problem is given. W.O.Lock

530.145

3958. A POSSIBILITY IN THE QUANTUM THEORY OF FIELDS. Yu.M.Lomsadze.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 887-9 (1956). In Russian.

Given a divergent series, it may be possible to find the correct function for which this is an (invalid) expansion. An example in terms of the pair theory of interaction of spinor fields is given. G.E.Brown

530.145

3959. VARIATIONAL PRINCIPLE AND VIRIAL THEOREM FOR THE CONTINUOUS SPECTRUM OF THE DIRAC EQUATION. Yu.V.Novozhilov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1084-6 (1956). In Russian.

A variational principle for the entire scattering amplitude as well as for the phase is derived. The virial theorem is obtained by varying the linear scale. G.E.Brown

530.145

3960. REPRESENTATION OF THE MESON FIELD BY RETARDED POTENTIALS. I.S.Arzhanykh.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 6, 953-6 (1956). In Russian.

An integral representation for the meson fields, which are defined by the Proca equations, is obtained with the help of the retarded solutions of the Klein–Gordon equation. G.E.Brown

530.145

3961. THE SCATTERING MATRIX OF THE COMPOUND SYSTEM. M.S.Livshits.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 1, 67-70 (1956). In Russian.

The non-Hermitian energy operator for the compound state is derived elegantly, and the scattering matrix is obtained. A close connection between the scattering matrix and the Wigener–Eisenbud characteristic matrix functions is established. G.E.Brown

530.145

3962. SCATTERING OF MESONS BY MESONS IN QUANTUM MESON FIELD THEORY. V.V.Sudakov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 2, 338-40 (1956). In Russian.

In general the asymptotic form of the amplitude for this process is a function of two arguments. For the special case in which the two arguments are equal, a simple equation for the amplitude can be found and solved. G.E.Brown

530.145

3963. GENERAL THEORY OF MESON SCATTERING. A.Brodskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 4, 787-90 (1956). In Russian.

The scattering amplitude is obtained in the form of integrals over scalar functions analogous to those of Lehmann (Abstr. 5288/1954). G.E.Brown

530.145

3964. ON A NEW NUCLEON–NUCLEON POTENTIAL.
E.Clementel and C.Villi.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 935-9 (Oct., 1956).

An attempt to include effects due to heavy mesons into the π-nucleon system treated in the static approximation. An extra term is introduced into the Langragian of the π-field involving the second derivation of the π-field variable and an additional parameter related to the cut-off length introduced in the usual treatments. The two-body potential arising has many of the features required by the available experimental data on the two body nucleon–nucleon interactions. D.J.A.Prowse

530.145

3965. A SIMPLE TREATMENT OF MESON–NUCLEON SCATTERING. S.F.Edwards and P.T.Matthews.
Phil. Mag. (Eighth Ser.), Vol. 2, 176-81 (Feb., 1957).

It is shown that the p-wave meson–nucleon scattering cross-sections can be very simply explained by calculating the first-order effective potential between meson and nucleon and the scattering in this potential. Some comments are made on the S-wave problem and virtual heavy meson effects. A.

530.145

3966. DERIVATION OF DISPERSION RELATIONS FOR FORWARD SCATTERING. K.Symanzik.
Phys. Rev., Vol. 105, No. 2, 743-9 (Jan. 15, 1957).

The dispersion relation for forward meson–nucleon scattering is derived in the simplified case of scalar neutral particles. Use is made of the local property of the nucleon field and of certain features of the mass spectrum. In addition, it is assumed that the only singularities of certain matrix elements of the nucleon field commutator are derivatives of finite order of δ functions on the light cone. Under some further assumptions of existence, the dispersion relations for the derivatives of the scattering amplitude with respect to angle at zero angle can also be derived. A.

530.145

3967. LEVEL DENSITY OF A SYSTEM OF FERMI PARTICLES. N.Rosenzweig.
Phys. Rev., Vol. 105, No. 3, 950–6 (Feb. 1, 1957).

Formulae for the density of the energy levels of a system of independent Fermi particles are derived which are valid for all values of the excitation energy, and thus a criterion for the validity for the usual (high-degeneracy) formulae is obtained. It is shown that as the energy of the system increases, the degree to which the usual (high-degeneracy) formulae are modified, depends strongly on the distribution of the individual-particle levels. If the levels are spaced uniformly, the corrections are especially small. Applications to nuclei are discussed briefly. A.

530.145

3968. APPLICATION OF FORMAL SCATTERING THEORY TO MANY-BODY PROBLEMS. L.L.Foldy and W.Tobocman.
Phys. Rev., Vol. 105, No. 3, 1099-100 (Feb. 1, 1957).

It is pointed out that the Lippmann–Schwinger integral equation, as it is usually written, does not necessarily have a unique solution when applied to the motion of three or more bodies. It follows that a certain amount of caution must be exercised in using the Lippmann–Schwinger equation as the basis for an approximation procedure. A.

530.145

3969. MULTIPLE SCATTERING BY QUANTUM-MECHANICAL SYSTEMS. K.M.Watson.
Phys. Rev., Vol. 105, No. 4, 1388-98 (Feb. 15, 1957).

A simple description is given of the quantum-mechanical theory of multiple scattering. The separation of the scattered wave into "coherent" and "incoherent" parts is discussed in greater generality than has been done previously. Applications to transport theory are described. Specific calculations are made of the refractive index of a medium which is "polarized" by the scattered particle (Lorentz–Lorenz formula) and also of a medium which has correlated structure (critical opalescence). Other applications are given. A.

530.145

3970. STRONG COUPLING. A.Pais and R.Serber.
Phys. Rev., Vol. 105, No. 5, 1636-52 (March 1, 1957).

For the case of the charged scalar theory a class of rigorous transformations is described which brings into explicit evidence the dependence of the Hamiltonian on the charge of the system. These transformations are noncanonical, nonadiabatic, and nonlinear. The strong-coupling Hamiltonian is obtained as a special case and is given in closed form. It is shown that in static approximation there exist bound states for arbitrarily high value of the charge of the isobar. The validity of the expansion method dealing with nonstatic effects is discussed, and it is shown that the usual strong-coupled procedure at best has meaning only for finite source size. The definition of nucleon-one meson states in the presence of finite isobar level separations is treated. A.

530.145

3971. HEISENBERG OPERATORS IN A LAGRANGIAN FORMALISM. P.J.Redmond.
Phys. Rev., Vol. 105, No. 5, 1652-5 (March 1, 1957).

The expressions for the S-matrix and the reduction formulae found by Lehman, Symanzik, and Zimmerman are derived from a Lagrangian formalism. A.

530.145

3972. UNIQUENESS OF SOLUTIONS OF THE BETHE–SALPETER EQUATION FOR SCATTERING. S.Mandelstam.
Proc. Roy. Soc. A, Vol. 237, 496-512 (Nov. 20, 1956).

The Bethe–Salpeter equation for nucleon–nucleon scattering is a singular integral equation, and it is therefore not certain that a unique solution exists. It is shown that the equation is soluble for states of all angular momentum, parity and isotopic spin if, and only if, $g^2/4\pi$ is less than $\frac{1}{6}\pi$. The range of values of g for which there exist solutions of a particular angular momentum and parity is given. The Bethe–Salpeter equation for meson–nucleon scattering is also examined. In this case, the equation is soluble for all values of the coupling constant, but the solution, regarded as a function of g, will exhibit discontinuities when g passes through certain values. A.

530.145

3973. OBSERVATIONS ON MIXED MESON THEORIES.
A.D.Galanin and L.I.Lapidus.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 359 (1956). In Russian.

Briefly reviews previous work (Abstr. 2187/1950; 8524/1951) on the theory of mixed pseudo-scalar, pseudo-vector mesons with pseudo-vector coupling and points out a relation between the meson masses and coupling function. J.W.Gardner

530.145

3974. DISPERSION RELATION FOR ARBITRARY SCATTERING ANGLE. E.S.Fradkin.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 515-17 (1956). In Russian.

Derives a connection between the real part of the scattering amplitude at an arbitrary angle in the centre-of-mass system to its imaginary part in the same system. J.W.Gardner

530.145

3975. CONSEQUENCES OF RENORMALIZABILITY OF PSEUDOSCALAR MESON THEORY WITH TWO INTERACTION CONSTANTS. V.V.Sudakov and K.A.Ter-Martirosyan.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 899-901 (1956). In Russian.

The procedure of Shirkov (Abstr. 1065/1957) is reformulated, using renormalization group techniques. G.E.Brown

530.145

3976. CONTRIBUTION TO THE THEORY OF SCATTERING OF PARTICLES BY A FIXED CENTRE [OF FORCE] WITH DAMPING TAKEN INTO ACCOUNT. A.A.Sokolov and B.K.Kerimov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1080-1 (1956). In Russian.

Expressions for phase-shift and for differential cross-section are given in accordance with a theory in which damping is taken into account. These expressions are applied to "rectangular" potential and to a δ-function type of potential, both in three dimensions. The results are compared with those obtained by alternative methods of calculation. R.Eisenschitz

530.145

3977. STATIC SOLUTION OF A NON-LINEAR MESON EQUATION. V.G.Yaichnitsyn.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1082-3 (1956). In Russian.

The static approximation to $\Box\varphi - k_0^2 - \lambda\varphi^3 = 0$ is considered. The asymptotic behaviour is considered and from values obtained here, numerical integration is carried out. G.E.Brown

530.145 : 539.18

SCATTERING OF NUCLEONS AND ANTINUCLEONS ON NUCLEONS. See Abstr. 3721

530.145

3978. CO-VARIANT ONE-TIME FORMULATION OF THE MANY-BODY PROBLEM IN THE QUANTUM THEORY. W.Królikowski and J.Rzewuski.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 3, No. 7, 353-9 (1955).

A covariant one-time formulation is obtained by transforming the conventional many-time equations into other equivalent equations which relate only those values of the wave-function and its derivatives which correspond to one space-like hypersurface σ.

G.E.Brown

530.145

3979. NEW IDEAS ABOUT SYSTEMS OF PARTICLES IN THE CAUSAL INTERPRETATION OF WAVE MECHANICS. L.de Broglie and J.Andrade e Silva.
C.R. Acad. Sci. (Paris), Vol. 244, No. 5, 529-33 (Jan. 28, 1957). In French.

Extending de Broglie's theory of the causal interpretation of wave mechanics, the authors introduce two new ideas and apply them to the case of a system consisting of two interacting particles.

P.M.Davidson

530.145

3980. EXCITATION OF MACROSCOPIC OSCILLATIONS BY QUANTUM FLUCTUATIONS. A.A.Sokolov, D.D.Ivanenko and I.M.Ternov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 2, 334-7 (1956). In Russian.

Transitions between quantum energy states of an electron in a periodic magnetic field give rise to a feedback effect which could lead to electronic resonance kindred to the nuclear resonance effect. The feasibility of observing such oscillations macroscopically is discussed in terms of the uncertainty principle, which imposes rather severe practical limitations on the magnetic field.

J.W.Gardner

530.145 : 535.34.07

3981. GEOMETRICAL REPRESENTATION OF THE SCHRÖDINGER EQUATION FOR SOLVING MASER PROBLEMS. R.P.Feynman, F.L.Vernon, Jr and R.W.Hellwarth.
J. appl. Phys., Vol. 28, No. 1, 49-52 (Jan., 1957).

A simple, rigorous geometrical representation for the Schrödinger equation is developed to describe the behaviour of an ensemble of two quantum-level, noninteracting systems which are under the influence of a perturbation. In this case the Schrödinger equation may be written, after a suitable transformation, in the form of the real three-dimensional vector equation $d\vec{r}/dt = \vec{\omega} \times \vec{r}$, where the components of the vector $\vec{r}$ uniquely determine ψ of a given system and the components of $\vec{\omega}$ represent the perturbation. When magnetic interaction with a spin $\frac{1}{2}$ system is under consideration, "$\vec{r}$" space reduces to physical space. By analogy the techniques developed for analysing the magnetic resonance precession model can be adapted for use in any two-level problems. The quantum-mechanical behaviour of the state of a system under various different conditions is easily visualized by simply observing how $\vec{r}$ varies under the action of different types of $\vec{\omega}$. Such a picture can be used to advantage in analysing various maser-type devices such as amplifiers and oscillators. In the two illustrative examples given (the beam-type maser and radiation damping) the application of the picture in determining the effect of the perturbing field on the molecules is shown and its interpretation for use in the complex Maxwell's equations to determine the reaction of the molecules back on the field is given.

A.

530.145

3982. FURTHER REFINEMENTS ON THE BRILLOUIN–WIGNER PERTURBATION PROCEDURE. E.Feenberg and P.Goldhammer.
Phys. Rev., Vol. 105, No. 2, 750-5 (Jan. 15, 1957).

The first-order correction to the wave-function in the Brillouin–Wigner perturbation procedure is generalized by associating independent amplitude coefficients G_x with each physically distinct type of interaction $W^{(x)}$ occurring in the interaction operator. The modified formulae for wave-function and energy can be evaluated by using only quantities which occur in the original formulation of the perturbation procedure (characterized by $G_x = 1$). The energy formula is invariant under a transformation which changes the scale of all energy denominators by a constant factor. A uniform displacement of the zeroth-order energy spectrum provides an additional variational parameter. A simple example is worked out to show how the computed energy improves as the amplitude parameters are displaced from $G_x = 1$ to optimum values. An incidental result is the observation that the statistical weight of the first order correction to the wave-function depends strongly on the amplitude parameters. Finally, results for degenerate and nondegenerate zeroth order states are embodied in an effective interaction operator which determines the energy and the correct zeroth-order linear combination.

A.

530.145

3983. A VARIATIONAL METHOD FOR THE CALCULATION OF PARTICLE DENSITIES AND SUMS OF EIGENVALUES IN WAVE MECHANICS. N.H.March.
Proc. Phys. Soc. A, Vol. 70, Pt 3, 169-75 (March, 1957).

Adopting a recent proposal made by Macke (Abstr. 93, 938/1956), the problem of calculating approximate particle densities and sums of eigenvalues by a variational method is examined thoroughly for the case of particles moving along the x-axis in a given potential. An Euler equation is derived, which can, in principle, be solved to obtain the best possible density in the sense of the restricted variational method employed. Connection is made with previous work of von Weizsäcker, and it is pointed out that the solution of von Weizsäcker's s equation may often be used to obtain a good initial approximation to the optimum results of the present treatment. Illustrative calculations have been carried through for the linear harmonic oscillator with the first ten levels singly occupied, and the results for the particle density are extremely encouraging.

A.

530.145

3984. PROBABILITY SPACES IN QUANTUM MECHANICS. I. A.Medina.
Rev. Mexicana Fís., Vol. 5, No. 1-2, 53-67 (Jan.-April, 1956). In Spanish.

Each quantum mechanical operator is associated to a projection operator and it is shown that these projection operators satisfy a set of properties identical to those of a probability field. By suitable metric considerations it is possible to obtain complete sets of commuting observables having, within certain limits, preassigned eigenvalue spectra. The introduction of new operators starting from the groups expressing the symmetries of the system is also discussed.

L.Pincherle

530.16 : 534.01 : 538.566

3985. GENERAL THEOREMS ON THE EQUIVALENCE OF GROUP VELOCITY AND ENERGY TRANSPORT. M.A.Biot.
Phys. Rev., Vol. 105, No. 4, 1129-37 (Feb. 15, 1957).

It is shown that under very general conditions there is a rigorous identity between the group velocity and the velocity of energy transport in nonhomogeneous media with or without anomalous dispersion. The medium is assumed to be nondissipative and the parameters such as density, rigidity, dielectric constant, etc., vary from point to point but are independent of the Cartesian coordinate lying in the direction of the mode propagation. This covers propagation in any type of waveguide, surface waves, propagation in stratified media, etc. The identity is established for fluids, for isotropic and anisotropic solids with or without prestress, and for electromagnetic waves. Anomalous dispersion is assumed to result from hidden coordinates such as electron oscillators. A new variational formulation of field theory is introduced. An interesting application is to wave propagation in an electron gas and it is shown that such wave propagation obeys the relativistic Schrödinger equation for a mass particle.

A.

530.162

3986. ON SOLUTIONS OF THE DIFFUSION EQUATION. A.M.Boigelot and H.G.Garnir.
Bull. Soc. Roy. Sci. Liège, Vol. 25, No. 1, 50-61 (Jan., 1956). In French.

Certain solutions of the diffusion equation in n-dimensional Euclidean space are defined as "weak", and a treatment is given which leads to the results already obtained by Lax and Milgram (Annals of mathematical studies, No. 33. Princeton, 1954. IX: Parabolic equations, pp. 167-189). By using the theorems of Tonelli and Fubini, it is shown that these conclusions depend on a less restrictive set of hypotheses than those used in the Lax and Milgram treatment.

N.Corcoran

530.162 : 536.7

3987. ON THERMAL FLUCTUATIONS IN DISTRIBUTED SYSTEMS. S.M.Rytov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 3, 371-4 (1956). In Russian.

The work of Callen et al. (Abstr. 6759/1951; 7053/1952; 1399, 1595/1953) in extension of the Nyquist theorem is itself extended to distributed systems.

R.F.S.Hearmon

530.162

3988. ON THE RELAXATION OF VIBRATIONAL NON-EQUILIBRIUM DISTRIBUTIONS. III. THE EFFECT OF RADIATIVE TRANSITIONS ON THE RELAXATION BEHAVIOR. R.J.Rubin and K.E.Shuler.
J. chem. Phys., Vol. 26, No. 1, 137-42 (Jan., 1957).

The extension of Pt I and II (Abstr. 7164/1956) to include the effects of concurrent radiative transitions on the relaxation behaviour. It was found that concurrent radiative transitions do not change the relaxation behaviour of the system of harmonic oscillators from that found previously for purely collisional transitions. The only change is in the time-scale of the relaxation in that the expressions obtained in Pt I must be multiplied by a factor of the form $\exp[-t/\tau]$ where τ is the lifetime of the oscillators in their excited vibrational and electronic energy levels. A.

530.162

3989. TRANSPORT EQUATION IN QUANTUM STATISTICS FOR SPINLESS MOLECULES. A.W.Sáenz.
Phys. Rev., Vol. 105, No. 2, 546-58 (Jan. 15, 1957).

An equation of transport is derived for dilute nondegenerate, gases of spinless molecules. The collision integral in this equation is expressed in terms of an exact cross-section for binary encounters which takes into account the identity of the colliding molecules. In this derivation the properties of Wigner distribution functions are used, also Kirkwood's time-averaging procedures, and physical assumptions essentially the same as those employed by Ross and Kirkwood in their recent derivation of a transport equation for gases of the above type. This equation reduces to theirs when the exact cross-section alluded to above is evaluated by means of the first Born approximation. It differs from that of Uehling and Uhlenbeck in a purely formal way, which has no practical consequences in the common domain of applicability of the two equations. A.

530.162 : 536.7

3990. FLUCTUATIONS AND IRREVERSIBLE THERMODYNAMICS. L.Tisza and I.Manning.
Phys. Rev., Vol. 105, No. 6, 1695-1705 (March 15, 1957).

The time-dependent theory of fluctuations is based on a combined application of the phenomenological theory of dissipation and the stochastic theory of random processes. The traditional method of joining these theories into a uniform scheme proceeds by adding a random perturbation to the differential equation of the phenomenological kinetic theory (the Langevin equation in case of Brownian motion). In the present approach the problem is considered as an essentially statistical one. The role of the differential equation is to fix the form of the distribution function over the manifold of fluctuation paths in function space. The solutions of the equation constitute the most probable region in function space and the fluctuations appear with their appropriate probabilities. The connection between the phenomenological equation and the distribution function is stipulated by means of a postulate, the essential ingredient of which is the auxiliary function recently introduced by Onsager and Machlup (Abstr. 420/1954). Heuristically this postulate was suggested by the kinetic analogue of Boltzmann's principle established by these authors. In the present logical structure it is sufficient to join this postulate to the standard assumptions of the phenomenological and the stochastic theories for the derivation of the entire time-dependent fluctuation theory. A number of statements usually postulated appears as theorems in this presentation. The reversible and irreversible aspects of time play an essential part in the argument. The calculation of fluctuations is carried out in the temporal and the spectral descriptions. The relation of the two schemes is discussed along with the scope and limitations of the theory. A.

530.162

3991. COUPLING BETWEEN THE [PROBABILITY] DISTRIBUTION OF A STATIONARY QUASIMONOCHROMATIC PROCESS WITH THE DISTRIBUTION OF ITS ENVELOPE. Ya.I.Likhter.
Zh. éksper. teor. Fiz., Vol. 31, No. 1(7), 148-9 (1956). In Russian.

A quasimonochromatic function $\xi(t)$ is defined by $\xi(t) = A(t)\cos[\omega_0 t + \varphi(t)]$ where $A(t)$ and $\varphi(t)$ are functions of t varying slowly in comparison with $\cos\omega_0 t$. A stationary quasimonochromatic random process is described by an arbitrary set of such variables $\xi(t)$. By the method of characteristic functionals the probability distributions for such sets, and their interrelations, are investigated. J.W.Gardner

530.17 : 534.01

3992. 'TWIXT EARTH AND SKY WITH ROD AND TUBE; THE MOBILITY AND CLASSICAL IMPEDANCE ANALOGIES. F.A.Firestone.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1117-53 (Nov., 1956).

The author presents a system of mechanical and acoustical analogies in place of the electrical analogies which are commonly used in solving mechanical and acoustical problems. Tables of pictorial symbols are given for constructing schematic diagrams both on the mobility and on the impedance analogies. Each connecting link is represented by a rod in the case of the mobility analogy, and by a hydraulic tube in the impedance analogy. The earth and sky are used as a frame of reference.

MECHANICAL MEASUREMENTS 531.7

531.714

3993. AN EXTENSOMETER MICROSCOPE STAGE FOR PHOTOELASTIC STUDIES IN RUBBER. E.H.Andrews.
J. sci. Instrum., Vol. 34, No. 3, 115-17 (March, 1957).

The instrument described is designed for attachment to the stage of a polarizing microscope in place of the conventional mechanical stage. Its purpose is to permit the use of a special compensator technique to determine stress distribution at the tip of a tear in an extended sheet of rubber. Examples are given of the stress distribution, both in magnitude and direction, at the tip of a tear in pre-vulcanized latex sheet, and the relative behaviours of the two principal stresses briefly discussed. A.

531.717.3 : 537.312.8

3994. A MAGNETO-RESISTANCE DISPLACEMENT GAUGE. I.M.Ross and E.W.Saker.
Nature (London), Vol. 178, 1196 (Nov. 24, 1956).

The displacement to be measured causes a small strip of InSb to change its position relative to a permanent magnet, the poles of which are shaped to give a strong field gradient in the direction of movement. The mean field over the crystal and hence its resistance are then a function of position. In practice two crystals rigidly connected are used to overcome temperature errors. G.F.Hodsman

531.732

3995. HOT WIRE LIQUID-LEVEL INDICATOR. A.Maimoni.
Rev. sci. Instrum., Vol. 27, No. 12, 1024-7 (Dec., 1956).

The theory of the method of measurement of liquid level by measurement of the resistance of a heated wire is developed, and it is applied to the design of a liquid-nitrogen-level indicator having a power dissipation of 3.4 mW/in. of length and a deviation from linearity in the calibration of less than 0.1 in. over its working length of 2.0 in. The apparatus should be applicable to the measurement of level of low viscosity liquids and its sensitivity is limited only by the temperature coefficient of resistance of the heated wire. A.

MECHANICS OF FLUIDS 532

532.13 : 532.72

3996. ACTIVATION ENERGY OF THE EYRING THEORY OF LIQUID VISCOSITY AND DIFFUSION. F.C.Collins.
J. chem. Phys., Vol. 26, No. 2, 398-9 (Feb., 1957).

The determination of the activation energy of the Eyring viscosity and diffusion theory from the isobaric temperature coefficient of the transport property is shown to be inconsistent with the assumed mechanism of the process. An alternative form of the Eyring theory makes use of an activation energy determined from the constant volume temperature coefficient of the transport property. Here the calculated viscosities and their isobaric temperature coefficients turn out to be in moderately satisfactory agreement with experiment in the case of several simple liquids. A.

532.133

3997. ANOMALIES IN THE TEMPERATURE DEPENDENCE OF THE VISCOSITY OF SUPERCOOLED LIQUIDS. S.S.Urazovskiĭ and P.A.Chernyavskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 3, 640-3 (1956). In Russian.

Viscosity measurements are made by a capillary method; the time during which a given quantity passes through the capillary can be measured with an accuracy of 0.01 sec. The temperatures are held constant within 0.01 deg. Nine different liquids are investi-

gated above and below their melting points. The logarithm of viscosity is plotted against the reciprocal absolute temperature. It is claimed that these graphs consist of rectilinear segments having different slopes. In this paper only one of these graphs is actually shown; it refers to menthol and shows two kinks. Generally the points of discontinuous slope are identified with the melting point of the liquid or transition points in the solid phase. R.Eisenschitz

532.133 : 541.64

3998. DEPENDENCE OF INTRINSIC VISCOSITY OF DILUTE SOLUTIONS OF MACROMOLECULES ON VELOCITY GRADIENT. Y.-H.Pao.
J. chem. Phys., Vol. 25, No. 6, 1294-5 (Dec., 1956).

For the general case for free-draining random coils, where the perturbations resulting from all the components of the velocity gradient tensor are considered, there is a dependence of steady-state shear viscosity on velocity gradient. Where all the relaxation times have nearly the same value the rotation and distortion of the coils compensate for each other and the intrinsic viscosity is independent of velocity gradient. G.Allen

532.133

3999. TEMPERATURE DEPENDENCE OF THE VISCOSITY OF LIQUID ARGON. N.F.Zhdanova.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 724-5 (1956). In Russian.

Viscosity of liquid argon is measured as a function of the temperature at constant density; at any given density, measurements start with the temperature of the vapour–liquid equilibrium and are extended upward near to room temperature. Densities are varied between 1.37 and 0.70 g/cm^{-3}. Results are shown in graphs; it would appear that the reciprocal viscosity is nearly a linear function of the temperature. At the higher densities the familiar exponential formula is nevertheless in agreement with measurements. At a density of 1.02 the coefficient of viscosity is virtually independent of the temperature; it decreases or increases with increasing temperature if the density is higher or lower, respectively. At constant temperature viscosity increases markedly with increasing density but the rate of increase is different for different isothermals; in the density–viscosity diagram all isothermals intersect in a single point corresponding to approximately double the critical density. R.Eisenschitz

532.217

4000. EXPERIMENTAL INVESTIGATION OF THE WAKE BEHIND A SPHERE AT LOW REYNOLDS NUMBERS. S.Taneda.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1104-8 (Oct., 1956).

Wakes produced by a sphere moving in a tank of water were photographically investigated at Reynolds numbers from 5 to 300. Main results obtained are as follows: (1) The critical Reynolds number at which the permanent vortex-ring begins to form in the rear of a sphere is about 24. (2) The size of the vortex-ring is nearly proportional to the logarithm of the Reynolds number. (3) The wake behind a sphere begins to oscillate at the rear of the permanent vortex-ring when Reynolds number of about 130 is reached. A.

532.5.032

4001. APPROXIMATE THEORY ON THE STABILITY OF INTERFACIAL WAVES BETWEEN TWO STREAMS. C.-M.Tchen.
J. appl. Phys., Vol. 27, No. 12, 1533-6 (Dec., 1956).

The stability of the interface of two superposed streams is studied by extending the theory of Helmholtz stability to include the viscosity and surface tension in the waves. The two uniform layers of incompressible fluids are of different densities, viscosities and stream velocities. Gravity, Taylor acceleration, and surface tension are taken into consideration. An approximate theory is developed and is valid in three ranges of wave-numbers. Neutral stability, rate of growth, and rate of decay are illustrated graphically. A.

532.511

4002. A NOTE ON HYDROMAGNETIC STABILITY PROBLEMS. R.J.Tayler.
Phil. Mag. (Eighth Ser.), Vol. 2, 33-6 (Jan., 1957).

It is shown that care must be taken in the application of the principle of interchange of stabilities, particularly to problems in which the wave-number/growth-rate relation contains transcendental functions. Particular application is made to recently studied problems of hydromagnetic stability. A.

532.517

4003. MOTION OF THE INTERFACE BETWEEN TWO IMMISCIBLE LIQUIDS OF UNEQUAL DENSITY IN A POROUS SOLID. R.E.Kidder.
J. appl. Phys., Vol. 27, No. 12, 1546-8 (Dec., 1956).

A general solution is obtained to a two-dimensional problem of the movement of the interface between two immiscible liquids of unequal density in a porous solid, the interface motion being the result of the force of gravity acting on the two liquids. The solution is obtained by direct potential theory methods and employs a method of approximation similar to that used in the linear theory of water waves. It is shown that the elevation of the interface above its equilibrium position satisfies a "nonoscillatory" wave equation, i.e. the classical wave equation in which the wave velocity is pure imaginary. The solution of the special case of an initially plane tilted interface is included. A.

532.517.2

4004. STABILITY OF LAMINAR FLOW IN CURVED CHANNELS. C.-S.Yih and W.M.Sangster.
Phil. Mag. (Eighth Ser.), Vol. 2, 305-10 (March, 1957).

Occurrence of secondary flow of a viscous fluid flowing under a pressure gradient in curved channels has often been explained by invoking the existence of boundary layers before the primary flow is established. In this paper it is shown that instability can occur even after the full establishment of the primary flow. Chandrasekhar's method is used in the analysis and the relationship between the stability parameter and the wave-number of the disturbance for neutral stability is obtained. A.

532.517.4 : 551.515.11

4005. SPECTRUM OF TURBULENT FLUCTUATIONS PRODUCED BY CONVECTIVE MIXING OF GRADIENTS. A.D.Wheelon.
Phys. Rev., Vol. 105, No. 6, 1706-10 (March 15, 1957).

Isotropic fluctuations of a passive scalar ψ produced by turbulent convection are investigated. The source of irregularities is considered to be the turbulent mixing of an established gradient of ψ. The mixing velocity field is described by Heisenberg's spectrum for homogeneous, isotropic turbulence. Replacing the (self-mixing) transfer of energy down the spectrum by an equivalent diffusion term, the local fluctuation spectrum becomes:

$$S(k) = (\nabla\psi)^2 \frac{1}{k^3} \frac{1}{[1 + (k/k_S)^4]^{4/3}} \frac{1}{[1 + (k/k_S)^{4/3}]^2},$$

where k_S is the viscosity cutoff wave number of the velocity field. In the inertial range ($k \ll k_S$) this result agrees with the spectrum deduced from purely dimensional arguments. Support for the above spectrum comes from the scattering of radio waves by dielectric fluctuations in the troposphere and ionosphere. A.

532.525

4006. INVESTIGATIONS OF THE HYDRODYNAMICS OF JETS OF LIQUID EMERGING FROM NOZZLES UNDER A PRESSURE UP TO 1500 ATM. L.F.Vereshchagin, A.A.Semerchan, A.I.Firsov, V.A.Galaktionov and F.M.Filler.
Zh. tekh. Fiz., Vol. 26, No. 11, 2570-7 (1956). In Russian.

After reviewing the literature the authors describe an apparatus for producing water jets in air. By applying high pressures velocities of 500 m/sec are attained; this is more than double the velocity which was reached by previous experimenters. By employing cinephotography the shape of the jets is observed in greater detail than known before. Apart from other results, it is noted that perturbations in the jet which arise near the velocity of sound recede at higher velocities. In this way high speed jets could be produced which show no tendency of breaking up, in spite of the presence of standing waves. It is pointed out that jets are appreciably heated up in nozzles on account of the Joule–Kelvin effect. R.Eisenschitz

532.527

4007. FLOW IN A VISCOUS VORTEX. C.D.Pengelley.
J. appl. Phys., Vol. 28, No. 1, 86-92 (Jan., 1957).

Equations habe been derived for velocity, temperature, and pressure distribution in a two-dimensional compressible viscous vortex with a steady-state component of radial flow. Radial velocity has been assumed small compared with the tangential component, and heat transfer has been neglected. The equations have been based upon the Navier–Stokes equation in its most general form, the first law of thermodynamics, and the gas laws. A reference radius has been defined where viscous stress is zero; from this, nondimensional forms have been set up and generalized charts prepared for ready visualization and numerical applications. Because of the classical concept of viscosity as used in the Navier–Stokes equation, results are strictly applicable to laminar flow only; a discussion is presented regarding possible application to turbulent flow. A.

532.528 : 534.13

4008. SOME NEW MEASUREMENTS ON SONICALLY INDUCED CAVITATION. E.Meyer.

J. Acoust. Soc. Amer., Vol. 29, No. 1, 4-8 (Jan., 1957).

This paper reports experimental investigations of the behaviour of single cavitation bubbles produced in water. In the first set high-intensity sound of frequency 14.6 kc/s is focused on a hydrophone. Oscillograms were made of the natural oscillations of the cavitation bubbles. In the second series of observations motion pictures were made of cavitation bubbles at the rate of 105000 frames a second. This enables the actual oscillations of the bubbles to be observed visually. A.

532.57 : 533.6.08

4009. USE OF COILED CAPILLARIES IN A CONVENIENT LABORATORY FLOWMETER. H.N.Powell and W.G.Browne.
Rev. sci. Instrum., Vol. 28, No. 2, 138-41 (Feb., 1957).

With coiled capillaries the basic simplicity of the Hagen–Poiseuille flow equation can be retained at flow rates which are not achievable with straight capillaries. The fact lends itself to the design of flow metering systems (for liquids or gases) which appear to be intrinsically more reliable and accurate than many other types of systems, and which require only commonly available laboratory apparatus. One such metering system for gases is briefly described. A.

532.59

4010. BULGING OF THE SURFACE OF A LIQUID UNDER THE INFLUENCE OF ULTRASOUND. M.Kornfel'd and V.I.Triers.
Zh. tekh. Fiz., Vol. 26, No. 12, 2778-80 (1956). In Russian.

The differential equations governing the formation of the bell-shaped hump produced on a liquid surface by an ultrasonic pencil are set up and solved. Experimental results for transformer oil and distilled water show satisfactory agreement with theory. R.F.S.Hearmon

532.591 : 534.2

4011. ROTATIONAL WAVES IN A TURBULENT LIQUID. R.V.L.Hartley.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 195-6 (Feb., 1957).

Equations are derived for the propagation in a liquid, in a state of fine-scale turbulence, of a type of so-called transverse wave in which the elasticity is associated with the rotation of an element rather than with its shearing as in a solid. This elasticity is proportional to the density of the kinetic energy of turbulent motion. The equations are identical with those for Kelvin's gyrostatic ether model and, for small displacements, are the analogue of those of Maxwell for free space. A.

532.593 : 551.465

4012. GROWTH OF LENGTH OF WAVES UNDER THE ACTION OF WIND. V.V.Shuleikin.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 6, 1049-52 (1954). In Russian.

A relationship is derived for the time dependence of wavelength and height of sea-waves. An approximate solution of this equation is found. Experiments carried out in a pond show that this expression described well the growth of wavelength with time. Z.Krasucki

CAPILLARITY 532.6

532.61

4013. CALCULATION OF SURFACE TENSION BY SHAPE OF DROP. N.N.Krasovskii, Yu.P.Nikitin, O.A.Esin and S.I.Popel.
Zh. fiz. Khim., Vol. 28, No. 9, 1678-9 (1954). In Russian. English translation in: Atomic Energy Res. Establ. (Harwell) Transl. No. 639, 3 pp. (1956).

Tables previously published for the calculation of surface tension from the shape of a drop have had to be based upon empirical data due to the lack of an analytical solution of the differential equation of the shape of the meridional section of the drop. The paper gives a graphical method of solution which is applicable to all shapes and sizes of drops provided they are symmetrical. The results are in good agreement with those provided by the tables. T.C.Toye

532.612 : 539.213.2

SURFACE TENSION AND STRUCTURE OF MOLTEN GLASSES.
See Abstr. 3749

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

4014. CELL METHOD COMPUTATION FOR LIQUIDS. H.B.Levine, J.E.Mayer and H.Aroeste.
J. chem. Phys., Vol. 26, No. 1, 207-14 (Jan., 1957).

A numerical equation of state for heavy rare gases in the neighbourhood of the critical point has been computed, using a cell model distribution function containing a parameter which correlates the probability of a distribution with the number of pairs of particles in adjacent cells for the distribution, as well as a variable mean number of particles per cell (range zero to one), a variable cell size, and a variable distribution of particles with respect to the cell centres. The energy was approximated by the sum of the interactions of pairs of particles in adjacent cells only, and the parameters of the distribution function were then chosen so as to minimize the Helmhotz free energy per particle at constant density and temperature. The critical constants were determined, and the vapour pressure and the molecular volumes of the liquid and gas phases in equilibrium with each other were determined as functions of the temperature near the critical temperature. An estimate was made of the improvement in the Helmholtz free energy to be expected from the inclusion of the interactions of nonadjacent particles in the calculation of the energy. A.

532.7 : 539.185

4015. ATOMIC DISTRIBUTION IN LIQUID ARGON BY NEUTRON DIFFRACTION AND THE CROSS SECTIONS OF A^{36} AND A^{40}. D.G.Henshaw.
Phys. Rev., Vol. 105, No. 3, 976-81 (Feb. 1, 1957).

The angular distribution of 1.04 A neutrons scattered by liquid argon at 84°K is reported. Small-angle scattering in the pattern is accounted for in terms of isotope incoherence using the same sign for the measured values of the scattering lengths of A^{40} and A^{36}. The transmission cross-section of A^{36} was measured for 1.04 A neutrons and found to be 77 ± 9 barns corresponding to a scattering cross-section of 73 ± 9 barns. The scattering cross-section of A^{40} was measured and found to be 0.36 barn. The scattering curve was transformed to the atomic density distribution $4\pi r^2[\rho(r) - \rho_0]$ for the liquid. The function shows only small oscillations about $-4\pi r^2\rho_0$ for spacings out to 3 A. Beyond this the curve oscillates about zero with an amplitude which decreases with increasing radius. The number of neighbours assigned to the first shell of atoms is 8.2. From a comparison of the position of the density cutoff and first density maximum with that expected for a Lennard-Jones 12 : 6 potential, it is concluded that the effective potential in the liquid has a broader bowl than that given by the Lennard-Jones 12 : 6 potential. A.

532.72 : 533.72

4016. THEORY OF THERMAL DIFFUSION UNDER LINEAR FLUID SHEAR. J.H.Ramser.
Industr. engng chem., Vol. 49, No. 1, 155-8 (Jan., 1957).

A mathematical theory of thermal diffusion under linear fluid shear is presented. The theory applies to all cases in which one wall of the thermal diffusion device moves uniformly with respect to the opposite wall. Equations for the steady state as well as for the approach to the steady state are derived under the condition that fluid motion due to natural convection and the variation of the "Soret constant" with concentration can be neglected. The results differ significantly in form from those derived by Debye for thermal diffusion under natural convection. A.

532.73 : 541.135

4017. APPLICATION OF FREE VOLUME THEORY TO ION PAIR DISSOCIATION CONSTANTS. W.R.Gilkerson.
J. chem. Phys., Vol. 25, No. 6, 1199-202 (Dec., 1956).

Using Kirkwood's zeroth-order partition function for a particle in solution, an equation has been derived for the dissociation constant of an ion pair. The equation contains three adjustable parameters: the distance of closest approach, a, of the ions; E_S, the difference in solvation energies of the ions and the ion pair; and $(gv\bar{v})$ which is a function of the free volumes available to the ions and ion pair. The latter two parameters account for specific solvent effects other than that due to the dielectric constant of the solvent. Comparison of the theory with the experimental data in several forms has been made. A.

532.73 : 541.135

4018. NUMERICAL SOLUTION TO THE POISSON–BOLTZMANN EQUATION FOR SPHERICAL POLYELECTROLYTE MOLECULES. F.T.Wall and J.Berkowitz.
J. chem. Phys., Vol. 26, No. 1, 114-22 (Jan., 1957).

The Poisson–Boltzmann equation for a penetrable spherical polyelectrolyte ion in the presence of smaller ions has been solved precisely by numerical integration methods using a high-speed computer. The polyelectrolyte ion was assumed in one case to be immersed in a sea of simple electrolyte and in another case to be surrounded by an appropriate volume of solution containing only the polyelectrolyte's counter ions. Since the absolute value of the electrostatic potential energy of a small ion in the centre of a polyelectrolyte ion is found to be several times kT, the nonlinear differential equation cannot justifiably be rendered linear by the Debye–Hückel type of approximation. The fraction of the counter ions held within the sphere of the polyelectrolyte ion is calculated from the solution to the differential equation. The extent of such ion association is found, for reasonable values of the molecular parameters, to range between 50 and 75% in substantial agreement with experimental observations based on transference studies. The results of the numerical computations are for the most part presented graphically. A.

532.73

4019. LIQUID IMMISCIBILITY IN METAL SYSTEMS. B.W.Mott.
Phil. Mag. (Eighth Ser.), Vol. 2, 259-83 (Feb., 1957).

An analysis is made of liquid immiscibility in metal systems. It is shown that the simple Hildebrand rule, which holds for non-polar liquids, can be modified to apply to metal systems, by the introduction of a new term which allows for the increased energy due to a difference in electronegativity of the components. The electronegativity term involves the maximum number of bonds which can form between two given metals, and is considered to be a function of their relative atomic sizes. On the theory suggested, out of a total of 529 alloy systems considered, 426 can be accounted for compared with 312 on the simple Hildebrand rule. Of the exceptions, several can be explained on the basis of errors in the calculation of the energy factors involved, and others can be brought into agreement on the assumption that the electronegativities of some specified elements vary with the elements with which they are alloyed. The application of the modified hypothesis to ternary systems is discussed. A.

532.74

4020. STATE OF ASSOCIATION OF WATER MOLECULES IN AQUEOUS SOLUTIONS AS DEDUCED FROM SOUND VELOCITY DATA. O.Nomoto.
J. Phys. Soc. Japan, Vol. 11, 1146-52 (Nov., 1956).

As the molecular compressibility $W = M/\rho\beta^{1/7}$, where M = mean molecular weight, ρ = density, and β = adiabatic compressibility, in usual liquid mixtures is a linear function of the molar fractions of the constituent liquids within experimental errors, but slightly deviates from linearity in aqueous solutions (Abstr. 7526/1953), this deviation was attributed to the structural change of water molecules in aqueous solutions by the influence of the solute molecules. Computation of the molar fractions (n_a, n_s) of the associated and the single molecules of water in dependence on the concentration has been performed for aqueous solutions of methanol, ethanol, n-propanol, iso-propanol and acetone using existing ultrasonic data. It was found that the change of n_a and n_s with concentration is characteristic of each solution and differs widely from one case to another. A.

532.77

4021. THERMODYNAMICAL PROPERTIES OF THE SODIUM–CADMIUM SYSTEM. A.F.Alabyshev and A.G.Morachevskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 2, 369-71 (1956). In Russian.

The electromotive force of sodium against sodium–cadmium mixtures was measured, using sodium glass as electrolyte. Measurements were made at temperatures at which all metals are liquid, i.e. 425 and 475° C. An accuracy of ±0.2 mV is claimed. Results are used for deriving the partial free energy of sodium, entropy and enthalpy of mixing and other thermodynamic quantities.

R.Eisenschitz

532.77

4022. THERMODYNAMIC AND TRANSPORT PROPERTIES OF THE SYSTEM ISO-OCTANE AND PERFLUOROHEPTANE. C.R.Mueller and J.E.Lewis.
J. chem. Phys., Vol. 26, No. 2, 286-92 (Feb., 1957).

While there are many experimental measurements on binary liquid systems, very few measurements have been designed specifically for statistical mechanical analysis. This paper describes an effort to design a series of experiments to secure all necessary information for theoretical analysis. The necessary measurements are those of vapour pressure, heats of mixing, variation of density with composition, and measurements of the viscosities of mixed vapours. This system of experiments is used on the system perfluoroheptane and iso-octane. The analysis of the data is discussed and calculations of the thermodynamic properties and intermolecular potential are carried out. A.

532.77 : 536.7

SEDIMENTATION OF FLUIDS. THERMODYNAMIC THEORY. See Abstr. 3217

MECHANICS OF GASES 533

533.15 : 533.7

4023. CLUSIUS AND DICKEL COLUMN CONSTANTS FOR A GAS CONSISTING OF HARD SPHERICAL MOLECULES. R.C.Srivastava.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 93-7 (Jan., 1957).

The theory of the Clusius and Dickel hot-wire thermal diffusion column, as developed by Furry and Jones (Phys. Rev., Vol. 69, 459, 1946) has been extended to take into account the temperature dependence of the gas coefficients for a gas whose molecules consist of hard rigid spheres. Tables for the shape factors h, k_C and k_d have been constructed by the method of numerical integration. It is found that the column constants, H, K_C and K_d depend strongly on the law of molecular interaction for the gas. The expressions obtained for the constant H are found to agree closely with the experimental data of Nier on helium. A.

533.275 : 537.523

4024. A FAST HYGROMETER USING POSITIVE POINT CORONA. N.E.Andersson and C.H.Hertz.
Appl. sci. Res. B, Vol. 5, No. 1-4, 179-81 (1955).

Suitable for plant transpiration measurements. The number of streamers formed per second is a measure of the humidity of the air blown directly into the discharge between a conical 0.3 mm Pt wire point at +3000 V and an earthed channelled electrode 4 mm away. An accuracy of ±1% for relative humidities of 30-100% at room temperature is claimed. A dimensioned cross-sectional diagram of the instrument is given. S.Weintroub

533.5 : 531.788.6

4025. FEEDBACK CONTROLLED HEAT CONDUCTIVITY GAUGE FOR MEASURING PRESSURE IN VACUUM SYSTEMS. J.H.Leck and C.S.Martin.
Rev. sci. Instrum., Vol. 28, No. 2, 119-21 (Feb., 1957).

Describes a simple feedback circuit for the hot wire Pirani gauge. This gauge is used for measurement at low pressures where the heat conducted away from a thin hot wire is a function of the gas pressure. The wire is included in a Wheatstone bridge circuit which serves both to heat the wire and to measure its temperature. In the circuit described the heat input is adjusted automatically so as to keep the wire temperature approximately constant over a wide range of pressure changes. This is achieved by supplying the power from a magnetic amplifier which is controlled by the wire temperature, a fall in temperature increasing and a rise in temperature decreasing the power supply. In this way pressure measurements can be made over the range zero to 3 mm Hg with wire temperatures of the order of 50 to 100° C by using either the feedback signal or the power output from the amplifier to give a measure of the pressure. A.

533.5 : 531.788.7

4026. THEORY OF AN IONIZATION MANOMETER. L.P.Khavkin.
Zh. tekh. Fiz., Vol. 26, No. 10, 2356-60 (1956). In Russian.

Simple approximate formulae are proposed for the functions of probability and efficiency of ionization in a wide range of electron energies. On the basis of the Morgulis' theory of the ionization manometer and the proposed approximations, formulae are derived connecting the sensitivity of the manometer with its dimensions and electrical parameters. The calculations are compared with experimental data. Z.Krasucki

533.5 : 531.788.7 : 537.542

IMPROVED IONIZATION GAUGE CONTROL CIRCUIT. See Abstr. 3387

533.6.011

4027. THE EFFECTIVE PRESSURE EXERTED BY A GAS IN TURBULENT MOTION. G.K.Batchelor.
"Vistas in Astronomy", Volume I, 290-5. See Abstr. 10 (1957).

The way is examined in which the effective mean pressure exerted by turbulent motion in a gas varies when the gas is subjected to an adiabatic homogeneous distortion. The results depend on the directional properties of the distortion and of the turbulence, and on the speed with which the distortion is carried out. In certain simple cases the effective normal pressure due to the turbulence is proportional to the nth power of the mean density, where n has a value which sometimes is as small as unity and sometimes as large as three. The dependence of total pressure (thermal plus turbulent) on mean density may therefore change when the turbulent pressure becomes greater than the thermal pressure, i.e. when the turbulent velocity fluctuations become supersonic. A.Beer

533.6.011.31

4028. APPLICATION OF THE M^2-EXPANSION METHOD TO COMPRESSIBLE FLOW PAST ISOLATED AND LATTICE AEROFOILS. I.Imai.
J. Phys. Soc. Japan, Vol. 12, No. 1, 58-67 (Jan., 1957).

In this paper two-dimensional compressible flow past an arbitrary aerofoil in an unlimited fluid or past a straight lattice of aerofoils is considered on the basis of the M^2-expansion method, which consists in expanding various quantities in powers of M^2, M being the Mach number. The general expressions for the velocity components at any point in the field of flow are obtained, which are correct to M^4 for an isolated aerofoil and to M^2 for a wing lattice respectively. In particular, the formulae giving the velocity distribution on the surface of the aerofoil are of such a simple form that the numerical calculation for any arbitrary aerofoil or lattice of aerofoils is no longer a prohibitive work, as generally believed. As an interesting special case, the flow past a symmetrical aerofoil placed symmetrically in a channel is also considered, which was previously dealt with by Goldstein and Lighthill by means of a different method. A.

533.6.011.31

4029. APPLICATION OF THE THIN-WING-EXPANSION METHOD TO THE COMPRESSIBLE FLOW PAST AN ELLIPTIC CYLINDER, WITH SPECIAL REFERENCE TO ITS FOURTH APPROXIMATION. Y.Matunobu.
J. Phys. Soc. Japan, Vol. 12, No. 1, 72-84 (Jan., 1957).

Both the complete and transonic thin-wing-expansion methods are utilized to obtain the steady irrotational flow of a compressible fluid past an elliptic cylinder. The velocity distribution over the surface is calculated up to the fourth powers in thickness ratio t. Then it is found that the fourth-order perturbations include not only terms of $O(t^4)$ but also those of $O(t^4 \log t)$, and that the latter group becomes negatively predominant over the former in the transonic range. Calculation of fluid velocity near the stagnation point still remains of insurmountable difficulty even for moderate subsonic flow. The resulting expressions for an elliptic cylinder may be transformed into those for a parabolic cylinder. A.

533.6.013.1

4030. ON RAYLEIGH'S PROBLEM FOR A GENERAL CYLINDER. J.C.Cooke.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1181-4 (Nov., 1956).

Rayleigh's problem, solved by Hasimoto for a general cylinder moving parallel to its length, is solved for small $\xi^2 = 4rt/R^2$, where R is the radius of curvature of the section, in a series in ξ, by a different and more straightforward method which exhibits the velocity distribution at any point explicitly. Five terms of the series are given and the skin friction is evaluated. This agrees to four terms with Hasimoto's result, which is as far as he gave the series. A.

533.6.013.2

4031. EXPERIMENTAL STUDIES ON THE SPECTRUM OF ISOTROPIC TURBULENCE BEHIND TWO GRIDS. H.Tsuji.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1096-104 (Oct., 1956).

As a continuation of the previous work (Abstr. 7758/1955), hot-wire measurements were made to determine the energy spectrum and decay of spectral components of turbulence behind two grids, the upstream grid having a larger mesh length than the downstream one, with a view to studying the characteristics of isotropic turbulence produced under various initial conditions and at high Reynolds numbers. Similarity of the energy spectrum holds only for high-wave-number range, while the low-wave-number characteristics of turbulence depend on the initial conditions and exhibit no similarity. On the other hand, similarity of the spectrum of vorticity is observed over almost entire wave-number region for the turbulence either behind single or double grids unless high-wave-number disturbances are superposed. Therefore, Lin's decay law, $\overline{u^2} \sim [x^{-1} + \text{const.}]$, is expected to be valid for the turbulence either behind a single grid or with superposed disturbances of low wave-numbers. Although superposed disturbances in high wave-numbers destroy similarity of the spectrum, the disturbances decay out rapidly and the similarity spectrum is stable. A.

533.6.08

4032. A DEVICE FOR CALIBRATION OF ANEMOMETERS FOR AIR FLOW OF LOW VELOCITIES. Y.Omori.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1191-200 (Nov., 1956).

A device has been made to calibrate anemometers at low speeds (a few cm/s to 2 m/s) of air streams. It consists of a wind-tunnel and a shaped nozzle, and anemometers are placed in the tunnel. The speed in the tunnel magnified by the nozzle is obtained from simple pressure measurement, and the initial speed is determined by conversion. Although the method is not new in principle, there are problems to be solved for actual use, and detailed experiments have been made to clear up the characteristics of the tunnel and the nozzle which will be suitable for the purpose, including the curvature and roughness of the surface of the nozzle, the length of the cylindrical part of the nozzle, the ratio of the sectional area of the nozzle to that of the upstream pipe etc. As a result it has been found that the conversion chart may be applicable to nozzles of somewhat varying profiles when they are within some proper, fairly wide range as regards the above factors. This gives convenient guidance on construction of the device. The device constructed by taking such a result into consideration does not seem to be inferior in accuracy and is more convenient practically in comparison with the whirling-arm method. A.

533.6.08 : 551.508.5

4033. A LINEAR, TEMPERATURE COMPENSATED HOT-WIRE ANEMOMETER. E.L.Deacon and D.R.Samuel.
J. sci. Instrum., Vol. 34, No. 1, 24-6 (Jan., 1957).

A hot-wire anemometer is described which gives a linear output over the range of wind speed 1 to 16 m/sec and is therefore well suited to studies of atmospheric turbulence. It is also provided with temperature compensation so that the effects of air temperature fluctuations (both rapid and slow) are eliminated. These desiderata are achieved with little increase in complexity over the simple hot-wire circuit. A.

MOLECULAR THEORY OF GASES 533.7

533.7

4034. THE BASIS OF KINETIC THEORY — BOLTZMANN'S EQUATION. S.Marquet.
C.R.Acad. Sci. (Paris), Vol. 243, No. 17, 1193-6 (Oct. 22, 1956). In French.

An appropriate measure is introduced in the velocity space of the n-particle problem. Average values calculated with this measure satisfy an equation which, under certain conditions, leads to Boltzmann's equation. It is shown that molecular chaos is conserved. E.H.Sondheimer

533.72 : 532.5

4035. AN EFFECT IN THE MOTION OF AEROSOL PARTICLES. Ya.I.Kogan and R.S.Repina.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 4, 851-4 (1956). In Russian.

The authors have found, in the case of a laminar aerosol flow in a vertical conduit with smooth walls, that, besides the Brownian movement which causes the diffusion-type sedimentation, there exists also a horizontal movement of the particles, which increases the sedimentation for the upward flow, but decreases it in the case of downward flow. Results are presented graphically for the passage of aerosol particles (r from 0.015 to 3.0 μ) through a vertical capillary glass tube (length 100 cm, bore 0.2 mm) at flow rates of 1.0 and 0.5 cm^3/min, for both directions. The concentration and size composition of aerosol particles at either end of the tube was determined by means of radiography; aerosols were obtained by atomization of solutions of $NaNO_3$ in HNO_3, the salt being activated by Po. It was found that, for particles of $0.015\,\mu < r < 0.3\,\mu$, the experimental results agreed well, regardless of direction, with those calculated from the Brownian movement only. In the case of larger particles the results for downward flow remained near the theoretical

curve, but those for upward flow disclosed an abrupt decrease of flow as the particle size increased. A tentative qualitative explanation of the observed effect is proposed. F.Lachman

533.72 : 532.72

THEORY OF THERMAL DIFFUSION UNDER LINEAR FLUID SHEAR. See Abstr. 4016

533.73

4036. DERIVATION OF THE VIRIAL THEOREM FROM THE GENERALIZED HELLMANN--FEYNMAN THEOREM.
A.A.Frost and P.G.Lykos.
J. chem. Phys., Vol. 25, No. 6, 1299-300 (Dec., 1956).

Starting from the fact that the derivative of the energy eigenvalue with respect to some parameter contained in the Hamiltonian is equal to the average (using exact wave-functions) of the derivative of the Hamiltonian with respect to the parameter, Slater's virial theorem for a diatomic molecule (1933) is derived by considering a (non-dimensionless) scale transformation of the coordinates, with the scale as parameter. F.Ansbacher

VIBRATIONS. ACOUSTICS 534

534.01 : 530.17

MOBILITY AND IMPEDANCE ANALOGIES FOR SOLVING MECHANICAL AND ACOUSTICAL PROBLEMS. See Abstr. 3992

534.01 : 538.566 : 530.16

GENERAL THEOREMS ON THE EQUIVALENCE OF GROUP VELOCITY AND ENERGY TRANSPORT. See Abstr. 3985

534.112

4037. ON A TRANSIENT STATE RESULTING FROM EXCITATION OF A STRING BY A BOW. B.Bladier.
C.R. Acad. Sci (Paris), Vol. 242, No. 23, 2704-6 (June 4, 1956). In French.

534.121.2

4038. ON THE VIBRATION OF A CIRCULAR MEMBRANE WITH ADDED MASS. H.Cohen and G.Handelman.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 229-33 (Feb., 1957).

The characteristic frequencies of a circular membrane carrying a rigidly attached concentric circular mass of finite area and vibrating symmetrically are studied. The main problem is that of determining the ranges of the parameters for which the frequencies will always be above or always be below those of the unloaded case. One of the chief tools is the minimum principle appropriate to the problem. The first term in the asymptotic expansion of the higher frequencies is obtained. A.

534.121.2

4039. MODES OF VIBRATION OF THE INDIAN DRUM DUGGA OR LEFT-HAND THABALA. B.S.Ramakrishna.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 234-8 (Feb., 1957).

The dugga or the left-hand thabala is a companion drum to the right-hand thabala and the two together are widely used in India. The vibration characteristics of the latter which has a symmetrically loaded membrane were discussed previously where it was shown how this drum produces harmonic overtones. The left-hand thabala also has a loaded drumhead, but the loading is here eccentric. The boundary value problem of this drumhead is not separable, and hence there is no readily available method for computing its characteristic frequencies. An approximate theory for computing the frequencies of the lower modes is here developed under the assumption that for these modes the effect of the (unloaded) annular region on the loaded region may be replaced by a suitably determined elastic support around its boundary. This leads to the boundary value problem of a membrane with an elastic boundary support whose stiffness constant per unit length is a function of the polar angle. The problem is still unseparable, but the eigenvalues can be now computed by a boundary perturbation technique from those of a membrane with a boundary support of constant stiffness. Computed and measured frequency ratios agree within 7% or better. A.

534.13.08

4040. A METHOD FOR ANALYSING MECHANICAL MOTION. R.H.Quint.
Nature (London), Vol. 178, 1195-6 (Nov. 24, 1956).

In the frequency range 10-50 kc/s and amplitudes of the order of 0.002 in., effects take place which can lead to useful information concerning resonant vibrating numbers. A technique of analysis is described using a jewellers lapping paste applied in very small quantities to the surface of excited aluminium cylinders of varying radii up to $\frac{3}{8}$" dia. The paste piles up at the nodes. It is suggested that the technique may be applicable to more intricate shapes. G.F.Hodsman

534.131

4041. EQUIVALENT CIRCUIT OF A RESONANT, FINITE, ISOTROPIC ELASTIC CIRCULAR DISK. R.L.Sharma.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1153-8 (Nov., 1956).

The equivalent circuit of a finite circular disk resonant at any frequency corresponding to the first three axially symmetric flexural modes is obtained from a function of two dynamic variables: (1) the kinetic energy in the disk, (2) velocity of the mechanical motion. This function, called the equivalent mass, is computed over a domain of arguments which is of practical interest. The results indicate fairly good agreement between theory and practice. A.

534.131

4042. VIBRATION OF SIMPLY SUPPORTED FLAT PLATES SIMULTANEOUSLY TAPERED IN PLANFORM AND THICKNESS. B.Klein.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1177-81 (Nov., 1956).

Accurate solutions are given for the first three natural frequencies of symmetric flexural vibrations. The results are presented graphically, and the range of the values defining the geometry of the plate is considered large enough to cover most practical cases. A.

534.132

4043. ACOUSTIC CONSTANTS OF TUBE OF SMALL SECTION. I.Barducci.
Alta Frequenza, Vol. 25, No. 5, 355-77 (Oct., 1956). In Italian.

A theoretical investigation of the primary and secondary constants, having regard to viscosity and thermal conductivity, without any simplifying assumptions as to radius of tube and frequency. A parameter a is introduced, $= r_0\sqrt{\omega/\nu}$ where r_0 is the radius of the tube, ω the frequency, and ν the viscosity. The Helmholtz—Kirchhoff relations give approximate formulae for large a and for small a; the relationships deduced are derived from a treatment valid for all values of a, and tend to the Helmholtz—Kirchhoff values in the limiting cases. N.Corcoran

534.15 : 533.6.011.311

4044. WALL PRESSURE FLUCTUATIONS IN A TURBULENT BOUNDARY LAYER. W.W.Willmarth.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1048-53 (Nov., 1956).

When a turbulent boundary layer is produced by air flow past a solid surface, the turbulence in the boundary layer can generate a sound field in the free stream and will also induce fluctuating loads on the solid surface. If the surface is flexible, this motion will generate an additional sound field on both sides of the surface. In an initial investigation of the latter form of sound generation, suitable equipment has been developed to measure the fluctuating wall pressure in the turbulent boundary layer. The equipment includes a specially designed low noise and turbulence level wind tunnel and a small barium titanate transducer and preampliflier combination for frequencies up to 50 kc/s. The transducer and preamplifier may be useful for other applications. Using this equipment, some of the properties of the wall pressure fluctuations in a turbulent boundary layer have been measured. It was found that the spectrum of the wall pressure fluctuations extends to 50 kc/s and that the root-mean-square wall pressure was a constant portion (0.0035) of the free stream dynamic pressure for $0.2 < M < 0.8$ and $1.5 \times 10^6 < Re < 20 \times 10^6$. A few typical spectra are given for different values of the Reynolds number and Mach number. A.

534.2

4045. THEORY OF ELASTIC WAVES PRODUCED BY A SPHERICAL SOURCE FOR GENERALIZED BOUNDARY CONDITIONS. J.Vaněk.
Czech. J. Phys., Vol. 6, No. 4, 303-9 (Aug., 1956).

Both fundamental boundary-value problems for elastic waves produced by a spherical source are solved on the assumption that the boundary conditions on the surface of the source apart from being an arbitrary function of the coordinates are also an arbitrary function of time. A.

534.2

4046. TORSIONAL WAVE PROPAGATION IN HOLLOW CYLINDRICAL BARS. S.K.Clark.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1163-5 (Nov., 1956).

The characteristic equation governing the propagation of waves of pure torsion in a hollow cylindrical rod are developed, and values

of the characteristic numbers governing the velocity of torsion wave propagation for the first five modes of motion are presented for both solid rods and various geometries of hollow cylindrical rods. The extremes of geometry are also investigated, that is, the case when the radius of the hole in the rod approaches zero and the case where the wall thickness of the rod approaches zero. The presence of the central hole in the cylinder has no effect on the velocity of propagation of these waves for the primary mode, but for higher modes the wave velocities increase with decreasing ratios of wall thickness to outside diameter. A.

534.2

4047. WAVE PROPAGATION IN ELASTIC PLATES: LOW AND HIGH MODE DISPERSION. I.Tolstoy and E.Usdin.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 37-42 (Jan., 1957).

This is an analysis of dispersive properties of elastic plates in vacuo. For low modes there exists conclusive experimental verification of these properties. Model studies show prominent arrivals having the proper spectra and velocities for group velocity maxima and minima corresponding to several symmetric and antisymmetric modes. In addition, detailed calculations based upon exact formulae predict some new and as yet unconfirmed properties of plates, e.g., negative phase velocities. New results concerning high modes of propagation are also displayed. These modes are of considerable theoretical interest since they belong to the transition region between the domains of validity of the wave and ray theories. The structure of the symmetric and antisymmetric fiftieth mode dispersion curves illustrates that for a given angle of incidence the propagating energy will be either chiefly shear or chiefly compressional, passage from one to the other corresponding to energy transfer between symmetrical and antisymmetrical modes of propagation. Comparison with multilayered liquid waveguides is mentioned. A.

534.2

4048. FLEXURAL WAVES IN ELASTIC BEAMS OF CIRCULAR CROSS SECTION. H.N.Abramson.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 42-6 (Jan., 1957).

The exact equations of elasticity are employed in an investigation of the flexural vibrations of a solid circular cylinder. Contrary to previous work, it is shown that the phase-velocity-wavelength relation has an infinity of branches, thus overcoming objections, on physical grounds, which have been made to the earlier work. The three lowest branches of this dispersion relation are calculated, and these are used to study the rate of energy transmission in terms of group velocity. A.

534.2 : 533.6.011.311

4049. NOISE TRANSMISSION FROM BOUNDARY LAYER PRESSURE FLUCTUATIONS. R.H.Kraichnan.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 65-80 (Jan., 1957).

A theoretical study is made of noise spectra radiated by the vibration of thin, stiff, flat plates under the action of turbulent boundary layer pressure fluctuations. The transmitted radiation investigated arises from the streamwise convection of quasi-static pressure fluctuations by the steady flow and is critically influenced by the dispersive character of transverse wave propagation in the plates. At moderate subsonic Mach numbers and typical parameter values the total transmitted power varies approximately as the fifth power of Mach number, for sufficiently thin boundary layers. At lower Mach numbers the dependence may be flatter and near certain transonic velocities should be steeper. The dominant transmitted frequencies increase with Mach number, varying, under certain conditions, as Mach number squared. Plate parameters which importantly influence sound transmission included mass per unit area, size of independent plate sections, stiffness, and damping factors for the various vibrational modes. For sufficiently thin boundary layers, the transmitted spectrum shape is essentially independent of boundary layer thickness, but the total transmitted power varies approximately as the fourth power of the thickness. For thicker boundary layers, the dependence is flatter and the Mach number dependence is also flattened. Several possible procedures for reducing the noise transmission are mentioned briefly. A.

534.2

4050. ELASTIC WAVE DISPERSION IN A CYLINDRICAL ROD BY A WIDE-BAND SHORT-DURATION PULSE TECHNIQUE. J.Oliver.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 189-95 (Feb., 1957).

Dispersion of elastic waves in a cylindrical rod, determined experimentally by means of a wide-band short-duration pulse technique, compares well with theoretical curves of the classical theory. This method, compared to previous methods, extends to smaller values the range of the wavelength-to-diameter ratios which may be studied conveniently. One antisymmetric and two symmetric modes were studied. In addition, waves of a resonant nature associated with the ends of the rod were identified. A.

534.2

4051. PLANE WAVES IN A THERMOELASTIC SOLID. H.Deresiewicz.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 204-9 (Feb., 1957).

In an isotropic, thermoelastic solid shear waves are unaltered by thermal effects. However, two distinct dilatational waves exist, both of which are dispersed and attenuated by the medium. One of the waves (denoted the E-wave) is close in character to the pure elastic wave, the other wave (denoted the T-wave) is similar in nature to the pure thermal wave. The properties of the two dilatational motions are studied and relations are given expressing the variation, in each, of phase velocity, amplitude attenuation, and specific loss with impressed frequency. For the E-wave the result is verified that this disturbance propagates at the adiabatic velocity at low frequencies and at the isothermal velocity at very high frequencies. An explanation based on physical considerations is offered to account for this generally overlooked phenomenon. It is further found that the amplitude is attenuated exponentially as the square of the frequency at relatively low frequencies, but approaches a finite value as the frequency increases without limit. The specific loss reaches a maximum for the E-wave, a minimum for the T-wave, near the frequency whose period is equal to the relaxation time due to thermal currents. Finally, the ratios are computed of the amplitude of the temperature to the amplitude of the displacement in each of the two modes of motion. Numerical work indicates that, for metals at room temperature, the effect of coupling between elastic and thermal motions is very small. A.

534.21 : 532.517

4052. SMALL-SCALE ACOUSTIC STREAMING IN LIQUIDS. J.Kolb and W.L.Nyborg.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1237-42 (Nov., 1956).

By using special acoustical and optical arrangements, vortex motions are discovered in the vicinity of small vibrating sources in liquids. Of particular importance is the vigorous eddying that typically takes place near a vibrating gas bubble when it rests on a boundary. This bubble-associated streaming has been observed under a variety of circumstances, and apparently occurs quite generally. Especially violent and chaotic motions appear near bubbles of resonant size. The attendant highly localized convection and viscous stresses are probably very important as intermediate physical mechanisms for sonic irradiation effects. A.

534.213 : 532.123.08 : 539.32.08

4053. WAVE PROPAGATION AND THE MEASUREMENT OF THE ELASTIC PROPERTIES OF LIQUIDS AND SOLIDS. H.J.McSkimin.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1228-32 (Nov., 1956).

Diffraction effects as encountered in the measurement of acoustic attenuation at high frequencies are discussed with particular reference to low-loss materials. Because of its importance, the propagation of short wave-trains in cylindrical rods is considered in some detail. For longitudinal waves, losses resulting from mode conversion at the boundary are analysed. First-mode shear-waves are also considered. Brief notes regarding propagation in rods of small diameter-to-wavelength ratio and propagation in crystalline media are given. The advantages of using phase balance are illustrated by a description of two experimental techniques, one for determining elastic constants of small specimens (single crystals, for example), the other for measuring changes in stiffness moduli as small as one part in a million. A.

534.213

4054. ON WAVE PROPAGATION IN A RANDOM INHOMOGENEOUS MEDIUM. D.S.Potter and S.R.Murphy.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 197-8 (Feb., 1957).

This paper examines the calculation of the coefficient of variation of intensity for acoustic transmission in a randomly inhomogeneous medium. An equation for this coefficient is derived which is valid over the range of frequencies between the wave limit and the ray limit previously reported by other authors. A.

534.213.4

4055. RESONANT FREQUENCIES AND HIGH MODES IN LAYERED WAVE GUIDES. I.Tolstoy.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1182-92 (Nov., 1956).

When a boundary between two sections of a multilayered waveguide becomes a pressure or particle-veclocity node, the sections can be treated independently and the intersections of their character-

istic curves define two infinite lattices of points which give the quasi-resonant and antiresonant propagation frequencies of the complete waveguide. The antiresonant lattice points also give the group velocity maxima corresponding to the frequencies for which the modes of the waveguide are strongly coupled to the characteristic modes of an individual layer or section of the guide. The resonant lattice points give the group velocity minima corresponding to a somewhat weaker coupling with the complementary section. In addition to clarifying the physics of guided waves in layered media, these lattices accelerate the numerical procedures and lead, in the case of high modes of propagation, to useful approximations and/or simplifications of the exact solutions. A.

534.22 : 541.127

4056. SOUND SPEED IN A REACTING MEDIUM. E.L.Resler,Jr.
J. chem. Phys., Vol. 25, No. 6, 1287-8 (Dec., 1956).

Introduction of the reaction rate equations into the hydrodynamic equations leads to the conclusion that a smooth transition from one sound speed to another results without the artificial appeal to viscosity or heat conduction. W.Good

534.222.2

4057. THE REFLECTION AND TRANSMISSION OF SHOCK WAVES. I. THE REFLECTION OF A DETONATION WAVE AT A BOUNDARY. D.C.Pack.
Phil. Mag. (Eighth Ser.), Vol. 2, 182-8 (Feb., 1957).

It is shown that, for a shock wave advancing through any physically real barotropic medium, the nature of the reflected wave is uniquely determined by the relative shock impedance of the medium through which the incident wave passes and the medium upon which it falls. A simple criterion is found for determining the nature of the reflection of a detonation wave at the end of a block of explosive. Particular attention is paid to the examples of an explosive in contact with a gas, water or solid surface. Certain approximations, which may be useful when there is a reflected shock wave, are discussed. A.

534.222.2

4058. THE REFLECTION AND TRANSMISSION OF SHOCK WAVES. II. THE EFFECT OF SHOCK WAVES ON AN ELASTIC TARGET OF FINITE THICKNESS. D.C.Pack.
Phil. Mag. (Eighth Ser.), Vol. 2, 189-95 (Feb., 1957).

An examination is made of the variation with time of the pressure and velocity in an elastic target of finite thickness subject to the impact of a shock wave. The cycle of reflections and transmissions at the boundaries of the target is described in detail. A.

534.222.2 : 537.564

4059. STRUCTURE OF A SHOCK FRONT IN ARGON.
J.W.Bond, Jr.
Phys. Rev., Vol. 105, No. 6, 1683-94 (March 15, 1957).

Steady one-dimensional shocks of such strength that one degree of ionization is of importance are considered. The equation of state of argon is computed, equilibrium conditions behind the shock front are evaluated, and a recombination coefficient derived from detailed balancing. It is shown that for a given shock velocity the shock front is flat and nonluminous at first but soon becomes luminous with corresponding change in hydrodynamic variables and degree of ionization, and that the flat portion decreases in width with increasing shock velocity. A.

534.23 : 621.317.353.1

4060. CORRELATION METHOD OF MEASURING THE TRANSMISSION DISTORTION COEFFICIENT. M.A.Sapozhkov.
Akust. Zh., Vol. 2, No. 3, 279-84 (1956). In Russian.

The proposed experimental layout involves tapping the transmission system at two places and correlating the signals. In one path a phase-compensator is included. The method, which is developed theoretically, enables both the generalized distortion coefficient and the interference to be measured. C.R.S.Manders

534.23

4061. SIDE BRANCH INSERTION LOSS IN A MOVING MEDIUM.
R.F.Lambert.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1059-63 (Nov., 1956).

Studies of the insertion loss of a side branch resonant filter in moving air reveal that nonlinear excitation of the resonator and turbulence may influence the measured characteristic. These effects occur at relatively low Mach numbers for particular flow geometry patterns. The insertion loss is found to be destroyed for sufficiently high flow velocities. An interpretation of insertion loss values as averaged over a finite band of frequencies is also given some attention. A.

534.23

4062. ACOUSTIC PROPERTIES OF THE OCEAN BOTTOM AT BAHIA TODOS SANTOS, LOWER CALIFORNIA. C.W.Horton.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1243-7 (Nov., 1956).

The transmission data which were obtained at Bahia Todos Santos, Lower California, have been analysed. It is shown that at a frequency of 200 c/s the observed propagation agrees quite well with a formula developed by Camp and Eckart. This formula, which is based on the assumption that the bottom acts like an acoustic impedance, predicts that the observed pressure should decrease with the three-fourths power of the distance. When the data are fitted with the formula, one obtains an average value of .125 for the ratio of (ρc of the bottom/ρc of the water). A.

534.23

4063. DISK-LOADED TORSIONAL WAVE DELAY LINE. I. CONSTRUCTION AND TEST. P.Andreatch, Jr and R.N.Thurston.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 16-19 (Jan., 1957).

Torsional waves are propagated in a uniform diameter rod with the shear velocity $(\mu/\rho)^{1/2}$. On the other hand, the effective velocity is slower in a disk-loaded rod with alternate large-diameter and small-diameter sections. Because of the slower velocity, a disk-loaded rod will delay a signal longer than conventional ultrasonic delay lines of the same path length. This paper describes the construction of these disk-loaded torsional wave delay lines, and of electromechanical transducers for generating and detecting the torsional waves. The method of testing and the results of tests on the lines are presented. For example, a brass line having the disk diameter five times the diameter of the sections between the disks provided a delay of 114 μsec/cm at 32 kc/s. For contrast, the delay of a uniform diameter brass rod is only 4.5 μsec/cm. A.

534.23

4064. DISK-LOADED TORSIONAL WAVE DELAY LINE. II. THEORETICAL INTERPRETATION OF RESULTS AND DESIGN INFORMATION. R.N.Thurston.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 20-5 (Jan., 1957).

In order to account for the magnitude of the delays reported in Pt I, the effects of distributed mass and elasticity in the disk must be included in the analysis. Formulae for the torsional impedance at the inner circle of a thin annular elastic disk with a free outer boundary were first derived by H.T.O'Neil. One finds from these formulae that the structure can properly be represented by lumped electrical elements over a relatively wide frequency range. This electrical analogue is a tandem arrangement of identical low-pass filter sections for which formulae are conveniently available. Complicated elastic effects near the sudden change of diameter are not included in the theory, and these effects may account for the discrepancy between theory and experiment. Relatively simple empirical corrections should be possible after a sufficient number of tests. The design of disk-loaded delay lines is discussed in the light of the above mentioned analysis. A.

534.23

4065. THE EFFECT OF GAS BUBBLES ON SOUND PROPAGATION IN WATER. J.D.Macpherson.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 85-92 (Jan., 1957).

The effect of thin uniform bubble screens on sound propagation in water has been investigated over a frequency range of 15-100 kc/s for bubbles with diameters between 0.016 and 0.050 cm. The density of the bubble screen was varied from 1 bubble in 10 cm^2 to 4 bubbles per cm^2. The results obtained confirm to a considerable accuracy the theory originally proposed by Foldy (1944) and also provide values of the damping constants of gas bubbles which are consistent with those obtained from measurements on isolated bubbles. A.

534.23 : 532.7

4066. ON THE PRESSURE DEPENDENCE OF SOUND ABSORPTION IN LIQUIDS. I.Liebermann.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1253-5 (Nov., 1956).

The theory of the dependence of sound absorption on pressure is given for liquids in which absorption significantly depends on the two coefficients of viscosity: bulk viscosity and shear viscosity. The bulk viscosity, and therefore sound absorption, is shown to be related to the equation of state. The equation of state is derived for a liquid model in which the volume is determined by molecular distribution within two states. This equation of state possesses two characteristic constants; these can be numerically evaluated for an actual liquid by comparing the theoretical equation of state with pressure–volume relations available in tables. As an example, the characteristic constants of water are evaluated and used to compute

the effect of pressure on sound absorption. The theoretical prediction is in agreement with published observations. As a further example, ethyl alcohol is also treated. A.

534.23 : 536.21 : 539.374

4067. ULTRASONIC ATTENUATION CAUSED BY THERMOELASTIC HEAT FLOW. K.Lücke.
J. appl. Phys., Vol. 27, No. 12, 1433-8 (Dec., 1956).

Expressions for the attenuation of sound waves in a standard linear viscoelastic body have been derived and have been applied to the attenuation due to the thermoelastic effect. The thermoelastic attenuation for sound waves has been computed for single crystals and polycrystalline materials under application of the high-frequency approximation of sound propagation. For single crystals the attenuation in the main propagation directions have been computed explicitly for cubic and hexagonal crystals taking into account the anisotropy of the elastic properties and thermal expansion. Comparison with experiments in the megacycle region shows that the attenuation caused by heat flow between the grains of a polycrystalline specimen is usually overpowered by scattering at the grain structure. Also the computed attenuation caused by heat flow between the regions of compressions and rarefaction of the wave is for many materials much smaller than the measured values. For single crystals of certain metals, however, the computed and the measured values have the same order of magnitude. It can be shown that in these cases the attenuation is composed of a thermoelastic component and of a component resulting from dislocations. In zinc the two components can be separated experimentally and the agreement between the measured and the computed thermoelastic damping is very good. A.

534.23 : 539.371

ABSORPTION OF ULTRASONIC VIBRATIONS AS A CHARACTERISTIC OF THE ELASTIC PROPERTIES OF RUBBER.
See Abstr. 3768

534.231 : 536.2

4068. AERODYNAMIC MIXING IN A HIGH-INTENSITY STANDING-WAVE SOUND FIELD. W.R.Mickelsen and L.V.Baldwin.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 46-9 (Jan., 1957).

Aerodynamic mixing is of fundamental importance in many fluid flow processes, some of which have intense superimposed sound fields. The effect of a transverse sound field on the temperature field downstream from a line source of heat was investigated both analytically and experimentally. In moderately intense sound fields, the temperature field is affected only in the time-mean sense. In intense sound fields, the heat wake is substantially deformed so that both the time-mean and instantaneous temperatures are considerably reduced. A.

534.232

4069. THE POSSIBILITY OF AN ABSOLUTE CALIBRATION OF RADIATORS AND RECEIVERS OF SOUND WITH RESPECT TO RADIATION PRESSURE WITHOUT USING A RADIOMETER. V.A.Zverev.
Akust. Zh., Vol. 2, No. 4, 378-9 (1956). In Russian.

Taking the expression for the sound pressure on an absorbing wall it is shown how, using a receiver of sound of a frequency ω, modulated at a frequency Ω, providing the receiver accepts both frequencies, to effect an absolute calibration. C.R.S.Manders

534.232

4070. PERFORMANCE OF CERAMIC FERRITE RESONATORS AS TRANSDUCERS AND FILTER ELEMENTS. C.M.van der Burgt.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1020-32 (Nov., 1956).

In recent experiments the compositions and methods of preparation of various ferrites were varied with the aim of achieving optimum mechanical and piezomagnetic performance. Essential improvements were obtained by small cobalt substitutions in the chemical composition and by suitable modifications of the mechanical and thermal treatments. In continuous-wave operation, appropriate ferrites can excite radiation intensities up to at least 10 W/cm^2, with an electroacoustic efficiency of more than 75% up to 50 kc/s. So they are highly promising for underwater transmission and processing, in spite of their brittleness (ultimate tensile strength up to about 6 kg/mm^2). Wide-band hydrophones with linear frequency response and high pressure-sensitivity can also be built from such ferrites having magnetomechanical coupling coefficients at remanence up to almost 0.25, like Permendur. The total variation of the mechanical resonant and antiresonant frequencies of ferrite filter elements in the temperature range from +20 to +50° C, being 0.1-0.25% for existing commercial ferrites, has been lowered to 0.03% and less. Since the mechanical quality factors are usually much better than 2000, such ferrites can be profitably applied to the construction of electrical and electromechanical band filters. A.

534.232

4071. ACOUSTIC RADIATION FROM A STATIONARY CYLINDER IN A FLUID STREAM (AEOLIAN TONES). B.Etkin, G.K.Korbacher and R.T.Keefe.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 30-6 (Jan., 1957).

The equation for the radiated sound associated with body forces in a fluid is applied to the flow past a circular cylinder. The sound field is found to be related to the oscillating lift and drag forces which act on the cylinder. Quantitative predictions are made of the directionality and intensity of the field. Some experiments were conducted in a subsonic wind tunnel, in order to test the theory. The microphone was located both inside and outside the tunnel. Over-all sound pressure levels and sound spectra were measured with various cylinders mounted in the test section. There is qualitative agreement between the theory and the experimental results. A.

534.232 : 621.395.615

4072. PIEZORESISTIVE SEMICONDUCTOR MICROPHONE. F.P.Burns.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 248-53 (Feb., 1957).

A microphone using the piezoresistive effect of n-type germanium has been designed and constructed with a cantilever beam arrangement. Frequency response curves were taken in a sound field of 10 μb with the microphone in a bridge type circuit and biased with 9 and 18 mA. The microphone produces 10^{-11} W in the flat low-frequency range and peaks to 10^{-9} W at a resonance at 2570 c/s with a total bias of 18 mA in a bridge type circuit. Other designs of transducers and different types of semiconductor material are discussed. The performance of a germanium rod microphone is compared with a standard carbon-button transmitter. A.

534.232 : 534.785 : 621.395.613.37

4073. EAR-INSERT MICROPHONE. R.D.Black.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 260-4 (Feb., 1957).

It has been observed that an acoustic transducer placed at the ear can be used as a microphone to pick up the voice of the wearer. This paper presents the results of an investigation to determine the various factors which make possible the use of a microphone in the ear. The investigation, using a laboratory model dynamic ear-insert microphone and a protective headset, determined the relative importance of the two principal paths that conduct sound pressure from the mouth to the outer ear canal: (1) the air path around the head, and (2) the path through the head. The voice spectrum in the outer ear canal, contributed by the path through the head, was also obtained. It appears that the ear-insert microphone could compete with a conventional microphone in front of the lips only in an application where it is difficult to use the conventional microphone because of its size or its interference with other equipment. The investigation forms a basis for further study to determine whether the ear-insert microphone has a future as a practical communication device. A.

534.232

4074. RELATION BETWEEN EFFICIENCY OF QUARTZ TRANSDUCERS AND ULTRASONIC ABSORPTION COEFFICIENT OF LIQUIDS. I. S.Parthasarathy and P.P.Mahendroo.
Z. Phys., Vol. 147, No. 5, 573-6 (1957).

A relationship between the efficiency of a quartz transducer oscillating in organic liquids as expressed by the conversion of electrical input to the total heating and the ultrasonic absorption coefficients of those liquids has been worked out on the basis of experimental work carried out previously. A.

534.232

4075. RELATION BETWEEN EFFICIENCY OF QUARTZ TRANSDUCERS AND ULTRASONIC ABSORPTION COEFFICIENT OF LIQUIDS. II. S.Parthasarathy and P.P.Mahendroo.
Z. Phys., Vol. 147, No. 5, 577-81 (1957).

Following on from Pt I a relationship is established between the absorption coefficient of the liquid and the net ultrasonic efficiency of the crystal. A.

534.232 : 537.228.1 : 620.179.16 : 621.373.421.13

BARIUM TITANATE AS AN ULTRASONIC OSCILLATOR.
See Abstr. 3244

534.24

4076. REFLECTION OF SOUND BY THIN RODS IN WATER. L.M.Lyamshev and S.N.Rudakov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 1, 48-51 (1956). In Russian.

Rods of copper, brass, steel and aluminium about 1 mm diameter and 30 mm long are irradiated by a quartz transducer operating at 1 Mc/s. The input is in the form of rectangular pulses of duration 30 microseconds at a repetition rate of 50 per second. Four curves are plotted of the amplitude of the reflected wave as a function of

scattering angle. In particular the magnitude of the non-specular component is discussed with particular reference to the relative velocities of sound in the rod and in water. S.C.Dunn

534.24

4077. ON THE REFLECTION OF SOUND AT AN INTERFACE OF RELATIVE MOTION. J.W.Miles.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 226-8 (Feb., 1957).

The reflection of a plane wave of sound at an interface between two perfect fluids is considered. Previous analyses of Rudnick, Keller, Franken and Ingard are found in error as a result of improper boundary conditions. It is found that, in addition to the possibility of total reflection in some range of angles of incidence at all finite, relative speeds, there exists the possibility of a reflection coefficient exceeding unity for sufficiently high, supersonic speeds; in particular, resonance may occur at one or more angles of incidence. The question of stability of the vortex sheet separating the two fluids also is discussed. A.

534.242

4078. ON THE AERODYNAMIC FIELD NEAR AN ORIFICE IN AN EXTENDED RESONATOR. J.M.Bourot and R.Brun.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2004-6 (Dec. 17, 1956). In French.

Experiments to show that a narrow slot, in the median section perpendicular to the axis of a rectangular pipe which was driven from the ends by loudspeakers to give a field of varying particle amplitude and zero pressure change, caused two resonances (20 and 80 c/s). A theoretical expression is given. H.D.Parbrook

534.242

4079. THE DAMPING OF A HELMHOLTZ RESONATOR. M.Vlček.
Slaboproudý Obzor, Vol. 17, No. 10, 553-8; No. 11, 622-6 (1956). In Czech.

The resonator is damped by means of a thin porous membrane (e.g. a piece of cloth) stretched across its cavity, at a distance l from the aperture. For the purpose of analysis, it is assumed that the natural resonant frequencies of the membrane and the reactive component of its impedance can be neglected. It is further assumed that the acoustic waves propagate normally to the resonator. An equivalent circuit of the system is considered. This is employed to determine its acoustic impedance as a function of l and of the resistance of the membrane. The resulting formulae are comparatively simple, but not very accurate. An exact solution of the wave equation is derived; this takes into account also the second order effects. Comparison of the two solutions shows that the formulae derived from the equivalent circuit are incorrect at small l. The results were checked experimentally by means of a special resonator having a rectangular cavity and a circular aperture. A number of curves showing the acoustic resistance and the absorption coefficient of the resonator, are plotted as a function of l. It is found that the resistance rapidly increases at small l, while the absorption coefficient passes through a maximum. Effect of the membrane on the resonant frequency of the system is also studied and some experimental data are given. The frequency increases with increasing l. R.S.Sidorowicz

534.26

4080. CERTAIN CONSEQUENCES OF THE THEORY OF SOUND DIFFRACTION ON AN ELASTIC SPHERE. S.N.Rzhevkin.
Akust. Zh., Vol. 2, No. 4, 366-71 (1956). In Russian.

Rayleigh gave a solution of the problem of the diffraction of sound by an elastic sphere of dimensions small compared with the wavelength. The present paper gives a more extended analysis of the same problem. It is shown that the amplitude of the pulse oscillations of the surface of the sphere is determined by a complex impedance depending on the concentrated mass, internal elasticity and radiation resistance of the sphere. It is shown how to find the resonant frequency of the sphere. It is also shown that a resonating sphere of gas in a liquid draws in energy from a wavefront equal to λ^2/π. For such a sphere the amplitude of the vibration depends on the density of the internal gas and that of the external medium, and an expression is given for this dependence. The effect of viscosity on the oscillations is also considered. C.R.S.Manders

534.26

4081. A THEORY OF THE SHADOW ZONE DIFFRACTION OF UNDERWATER SOUND. W.J.Noble.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1247-52 (Nov., 1956).

The problem is reduced to that of diffraction by a dark half-plane and an asymptotic expansion of the edge-wave used to calculate the transmission anomaly. This theory explains the general shape and the observed break of the transmission anomaly curve. The dependence of the calculated values on range, wavelength, and depth, is shown to agree with recent observations. A.

534.26

4082. BACK-SCATTERING OF SOUND FROM THE SEA SURFACE: ITS MEASUREMENT, CAUSES, AND APPLICATION TO THE PREDICTION OF REVERBERATION LEVELS. R.J.Urick and R.M.Hoover.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1038-42 (Nov., 1956).

In many applications of underwater sound, the "reverberation", or backscattered return, from the sea surface is the limiting background in which the desired echo appears. Little has been known about sea-surface backscattering in spite of its importance to the prediction of reverberation levels in practical applications. Using two transducers — one for transmitting, one for receiving — mounted so as to be rotatable in a vertical plane and suspended from a buoy, measurements have been made of the backscattering of sound pulses from the surface of the sea as a function of grazing angle between 5 and 90°, wind speed between 3 and 18 knots, and pulse length. When converted to a scattering coefficient per unit area, the results provide some hints as to the processes by which sound is scattered by the ocean surface, and give the basic data for computing the reverberation to be expected with transducers of arbitrary beam width and orientation. A.

534.26

4083. SCATTERING IN AN INHOMOGENEOUS MEDIUM. E.Skudrzyk.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 50-60 (Jan., 1957).

The standard mathematical procedure formally describes scattering by the superposition of a scattered pressure on the unscattered sound field. At low frequencies, because of the irregular distribution of the inhomogeneities, the phases of the scattered waves are at random and scattering is an interference phenomenon. As the frequency increases, scattering becomes highly collimated in the forward direction and the phase differences decrease to zero. At this point ray theory starts to apply. The scattered pressure, then, essentially describes only a phase change caused by the different sound velocities and the focusing and defocusing by the lens action of the patches. The medium in the neighbourhood of the receiver can be shown to contribute only by focusing, the medium farther away only by interference fluctuations. Focusing leads to normally distributed amplitude fluctuations. The distribution of the interference fluctuations, however, passes from normal to Rayleigh with increasing values of range. A.

534.26

4084. SCATTERING OF SOUND BY SOUND. P.J.Westervelt.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 199-203 (Feb., 1957).

Owing to the inherent nonlinearity of the equations of motion for a perfect fluid, two or more sound waves passing through a common region will, in general, interact with one another and give rise to scattered waves. In this paper, a source function is obtained for the lowest order scattering process which is quadratic in the primary field variables. This function is rewritten in a form that demonstrates that no scattered waves exist outside the region of interaction of two sound beams intersecting each other at right angles. Furthermore, it is demonstrated that no such scattered waves exist when the two beams intersect at the angle

$$\theta = -\cos^{-1}\left[\tfrac{1}{2}\rho_0 c_0^{-2}\left(\frac{d^2p}{d\rho^2}\right)\rho = \rho_0\right],$$

where ρ, c and p stand for the density, sound velocity and pressure, respectively, and the subscript 0 means ambient values of these quantities. The interfering effect of pseudo-sound, induced by radiation pressure, is suggested as an explanation for the results of Ingard and Pridmore-Brown, who have reported recently what they believe to be scattered waves from the interaction region of two sound beams intersecting each other at right angles. A.

534.321.9

4085. NONDESTRUCTIVE TESTING BY ULTRASOUND. OBJECTIVES AND POTENTIALITIES. W.Roth.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 2-4 (Jan., 1957).

Ultrasonic propagation is affected by elastic properties of distribution of material and stress continuity. Since these are properties that determine structural strength of manufactured parts, ultrasound is useful for nondestructive testing. Variations in internal properties of structure can be detected, but it is often not possible to evaluate the effect that detected structural variations have on the ability of a part to function properly. This paper takes a critical view of the nondestructive testing field in the light of this objective. A.

534.39

4086. ACOUSTIC RADIATION PRESSURE. P.J.Westervelt.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 26-9 (Jan., 1957).

An expression obtained (Abstr. 5210/1951) by the author for the radiation force on a scattering obstacle with arbitrary normal impedance is now shown to be valid for any scattering obstacle. The derivation of the final expression for the force in terms of the asymptotic scattering function for the obstacle in the field of an incident plane wave is accomplished by taking into account the interaction of the incident wave with the scattered wave. Thus the former assumption of a perfectly collimated beam (1951) is avoided by considering the incident plane wave to be of infinite extent. The result for the force in the direction of the incident wave is

$$F_{\parallel} = c_0^{-1}\{\text{power scattered} + \text{power absorbed} - \int \Gamma_S \cos\theta dA\},$$

where c_0 is the velocity of sound, Γ_S is the magnitude of the mean scattered intensity, θ is the angle formed between the incident and scattered waves. This is the same result as that obtained in 1951. The expression given in 1051 for the force perpendicular to the incident wave is correct only for an object which scatters in a restricted way. The correct general expression for the perpendicular component of the force is $F_{\perp} = -c_0^{-1}\int \Gamma_S \cos\beta dA$ in which β is the angle formed between $F_{\perp}$ and Γ_S. A.

534.39

4087. NOTE ON ACOUSTIC RADIATION PRESSURE.
J.Awatani.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 392 (March, 1957).

A method of obtaining the acoustic radiation force (i.e., the process of integrating the force on every surface element of the object placed in sound waves) is criticized. This process yields the sum of the contribution of the true radiation pressure and that of the mean pressure. Though there is no effect in plane progressive waves, the mean pressure has a considerable effect on the result obtained in plane standing waves or progressive spherical waves. A.

534.442.2

4088. A QUICK ACTING SEARCH TONE SPECTROGRAPH FOR THE SPEECH FREQUENCY RANGE. S.Steinbach.
Nachrichtentechnik, Vol. 6, No. 9, 396-400 (1956). In German.

A continuation of a previous paper (Abstr. 187/1957). In the present paper details are given of the circuitry of the search tone spectrograph and specimen records are reproduced illustrating the characteristics of male and female voice sounds. A.B.Wood

534.612.4

4089. ABSOLUTE CALIBRATION OF MICROPHONES AT AUDIBLE AND INFRASONIC FREQUENCIES. V.Gavreau and A.Calaora.
C.R.Acad. Sci. (Paris), Vol. 243, No. 23, 1840-2 (Dec. 5, 1956). In French.

The particle amplitude in a sound field (0-400 c/s) at a probe tube microphone in either an anechoic room or an acoustically lagged pipe, was determined from the alternating phase-changes in an ultrasonic field of known wavelength superposed on the sound field. H.D.Parbrook

534.7 : 534.13

4090. RESPONSE OF THE HUMAN SKULL TO MECHANICAL VIBRATIONS. E.K.Franke.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1277-84 (Nov., 1956).

Measurements of the mechanical impedance and of the vibration pattern of the human skull are described. In the frequency range from 200 to 1600 c/s the skull was excited to vibrations by means of an electrodynamically actuated piston with small contact area. Data were obtained from living subjects, a dry skull preparation, and a human cadaver. The modulus of elasticity of skull bone, calculated from the resonance frequency of the skull, was found consistent with the value obtained by static methods. The propagation velocity of flexural waves in the skull bones, as calculated from the natural frequencies, agrees satisfactorily with the experimentally determined velocity. It is shown, finally, that a vibrating spherical shell is a suitable model for the skull and describes its vibration patterns with good approximation. A.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85

534.78 : 612.85

4091. SPEECH COMMUNICATIONS IN NOISE: SOME EQUIPMENT PROBLEMS. M.E.Hawley.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1256-60 (Nov., 1956).

The design of a speech communication system begins with an operations analysis of the communication problem. When speech has been chosen as the means and when the needed linkages have been determined, the designer chooses the best compromises among the frequently conflicting factors of intelligibility, safety, comfort, quality, reliability and economy. It is particularly important to provide good quality as well as adequate intelligibility. The latter may be predicted with reasonable accuracy if the noise and signal levels and the transfer characteristics throughout the system are known. Pressure gradient microphones, especially with noise shields, noise attenuating earcaps, and earplugs, are the primary acoustical devices that can be used to obtain high intelligiblity through improvement of signal-to-noise ratios. If the listeners are in intense noise, headsets presently pose the major systems limitation. Automatic volume control and peak clipping are the audio techniques most frequently used to complement the transducers. Typical values and limitations for these kinds of processing are given. Optimum results can be obtained only if the whole system is designed together. A.

534.78 : 534.232

4092. INFLUENCE OF NOISE UPON THE EQUIVALENCE OF INTENSITY DIFFERENCES AND SMALL TIME DELAYS IN TWO-LOUDSPEAKER SYSTEMS. D.M.Leakey and E.C.Cherry.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 284-6 (Feb., 1957).

The equivalence of intensity difference and time delay in two-loudspeaker systems is greatly affected by the presence of extraneous noise. An experiment is described in which this effect is measured with speech and wide-band noise. It is found that as the noise level is increased the equivalent intensity difference, for a given time delay, decreases, tending to zero for noise levels approaching the masking level. A.

534.781

4093. ELECTRONIC BINARY SELECTION SYSTEM FOR PHONEME CLASSIFICATION. J.Wiren and H.L.Stubbs.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1082-91 (Nov., 1956).

A successive-binary-selection system for automatic classification of spoken English into several groups of phonemes is described. The first step separates voiced from unvoiced by measuring the filtered output in the range of the pitch frequency. The next step separates turbulent (noise-like) from nonturbulent by measuring the filtered output in the range of the first formant. Nonturbulent sounds are classified into 6 groups of 2 or 3 phonemes each in successive selections based on spectrum measurements. For each of the two groups of phonemes being separated in a given step, a frequency band is chosen where phonemes of that group have large amounts of energy compared to those of the other group. The polarity of the weighted difference of the corresponding band-pass-filter outputs determines the classification. Unvoiced turbulent sounds are separated into stops and fricatives by means of the amplitude information contained in the onsets of these sounds. Two of the fricatives, |s| (see) and |s| (she), are separated by means of their zero-crossing-density levels. A.

534.782

4094. NOTE ON THE DESIGN OF "TERMINAL-ANALOG" SPEECH SYNTHESIZERS. J.L.Flanagan.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 306-10 (Feb., 1957).

The synthesis of vowel sounds by lumped-constant electrical networks having transfer functions similar to the transmission properties of the vocal tract is considered. A comparison is made between cascade and parallel connections of simple electrical resonators for producing vowel sounds. The cascade arrangement of resonators is shown to yield vowel sounds having formants of proper amplitude when information specifying the formant frequencies only is known. A.

534.784

4095. NOTE ON PITCH-SYNCHRONOUS PROCESSING OF SPEECH. E.E.David, Jr and H.S.McDonald.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1261-6 (Nov., 1956).

Voiced portions of speech waveforms are quasi-periodic in nature. This property arises from repeated excitation of the slowly changing vocal cavities by glottal puffs. Knowledge of this periodicity affords a means of reducing the channel capacity necessary to transmit a speech signal. One proposal to this end involves eliminating N–1 of every N pitch periods before transmission, where N is chosen small enough so that variations important to the ear-cortex in the intraperiod waveform are preserved. Thus, provided consonants are similarly chopped, the channel capacity in bits/second can be reduced by 1/N. At the receiver, missing parts are restored by interpolating them in a predetermined way, for example, by simply repeating each of the received periods N–1 times. Circuits for

operating on monotone speech demonstrating this principle have been constructed. Experiments with N = 2, 3, and 4 indicate that minor distortion, which appears as submultiples of the pitch harmonics, is thereby introduced. Consonants are little affected by the chopping. A similar scheme which involves eliminating portions of the waveform in each period was also investigated. Less satisfactory results were obtained here, since the intraperiod waveform carries the phonemic information. A.

534.784

4096. DETERMINATION OF THE SPEECH SPECTRUM THROUGH MEASUREMENTS OF SUPERPOSED SAMPLES. T.H.Tarnóczy.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1270-5 (Nov., 1956).

By recording on one magnetic tape the simultaneous utterances of several speakers saying unrelated things, a noise was obtained which is essentially time-invariant, has a continuous spectrum, and displays the average spectral properties of speech much more readily than methods employed heretofore. Spectral analysis of this speech noise has been performed. The advantages of the method are (1) the integration time needed for determining the long-time spectrum of speech can be reduced to a few seconds; (2) the combination of speech waveforms can be treated as a statistical noise constant in time; (3) this noise does not contain any line spectrum elements; (4) with normal speaking levels, better signal-to-noise ratios are obtained. The experiments suggest that different languages may be characterized by differences in the long-time average spectra. Spectra obtained by the present method were used to compute the average loudness level of a single speaker. The method is adaptable to measurement of the spectrum of a speech sound or of an individual mode of pronunciation. A.

534.784

4097. INFORMATION CONVEYED BY VOWELS. P.Ladefoged and D.E.Broadbent.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 98-104 (Jan., 1957).

Most speech sounds may be said to convey three kinds of information: linguistic information which enables the listener to identify the words that are being used; socio-linguistic information, which enables him to appreciate something about the background of the speaker; and personal information which helps to identify the speaker. An experiment has been carried out which shows that the linguistic information conveyed by a vowel sound does not depend on the absolute values of its formant frequencies, but on the relationship between the formant frequencies for that vowel and the formant frequencies of other vowels pronounced by that speaker. Six versions of the sentence "Please say what this word is" were synthesized on a Parametric Artificial Talking device. Four test words of the form b-(vowel)-t were also synthesized. It is shown that the identification of the test word depends on the formant structure of the introductory sentence. Some psychological implications of this experiment are discussed, and hypotheses are put forward concerning the ways in which all three kinds of information are conveyed by vowels. A.

534.784

4098. REALIZATION OF PROSODIC FEATURES IN WHISPERED SPEECH. W.Meyer-Eppler.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 104-6 (Jan., 1957).

Experiments utilizing a visible-speech analyser showed that changes of pitch in normal (voiced) speech are replaced in whispered speech by shifts of some formant regions accompanied by added noise between the higher formants. A.

534.784

4099. ACOUSTIC PROPERTIES OF STOP CONSONANTS. M.Halle, G.W.Hughes and J.P.A.Radley.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 107-16 (Jan., 1957).

The two major cues for stop consonants, the burst of the stop release and the formant transitions in the adjacent vowel, were investigated. Detailed energy density spectra of the bursts were prepared. The transitions were studied by means of sonagrams. Possible criteria for identification were developed and tested. In order to assess the efficacy of the two types of cue, perceptual tests were conducted with isolated segments that contained either stop bursts or vowel transitions alone. Common acoustical properties of bursts and formant transitions are noted; differences as well as similarities are discussed in the light of different varieties of pitch judgments. A.

534.836

4100. MEASUREMENTS OF TRAFFIC NOISE IN WEST GERMANY. F.J.Meister.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 81-4 (Jan., 1957).

Methods used in the measurement and evaluation of traffic noise in cities in West Germany are summarized. Particularly useful are the values of (1) the background level, (2) the mean peak levels, and (3) the average level (as obtained by a planimeter), evaluated for one-minute periods. For spectral considerations, the "summation spectrum" is used; this is the sum of the spectra of a variety of vehicles which therefore averages out the variations between individual sources. Typical measurements are presented. Steps taken to reduce the disturbance from traffic noise by redesign of public vehicles and by town planning are described. A.

534.837 : 621.3.018.6

4101. CALCULATIÓN OF THE MAGNETIC NOISE OF POLYPHASE INDUCTION MOTORS. P.L.Alger and E.Erdelyi.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1063-7 (Nov., 1956).

The origin of the magnetic driving forces which are responsible for magnetic noise and a method of calculating the mechanical response of the motor structure are reviewed. A general method is developed to calculate the sound pressure levels of magnetic noise at a specified point near the motor. Numerical results of calculations are given, and also the corresponding measured sound pressure levels of the magnetic noise for a particular experimental 4-pole, 30 h.p. polyphase induction motor under five different operating conditions; calculations agree with measurements within 3 dB. A.

534.843

4102. ANALOG CIRCUIT REPRESENTATION FOR WALL PANELS. A.D.Frost.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1285-91 (Nov., 1956).

A new approximate equivalent analogue circuit representation for wall panels in proposed. This circuit is in the form of an extended network of interconnected mesh structures. Solutions for the fractional energy transfer through the system are given for various source and boundary conditions. Experiments on a lightweight panel using a simulated plane wave source give values of transmission loss which are comparable to those using coupled chamber techniques. A.

534.843

4103. EFFECT OF THE SPLAYED WALLS OF A ROOM ON THE STEADY-STATE SOUND TRANSMISSION CHARACTERISTICS. T.Nimura and K.Shibayama.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 85-93 (Jan., 1957).

The steady-state sound transmission characteristics in model rooms of various shapes were measured. The shape of the model was varied from rectangle to trapezoid and to quadrangle with nonparallel walls, while the interior volume of the room was kept constant. In the results, it was observed that the trapezoidal rooms in which the ratio of l to a is about 10%, where a is the mean length of the parallel walls, and l is the difference between them, are effective in decreasing frequency irregularity in the transmission characteristics. On the other hand, the sound characteristics of a fan-shaped room, adopted as an example of splayed rooms, were analysed mathematically. The fan-shaped room with $\rho_0 \cong 1.2$-1.4 has good characteristics in low-frequency region, where ρ_0 is the ratio of the outer and inner radius of the room. Such a fan-shaped room corresponds to a splayed room with $l/a \cong 0.09$-0.17. The results are in good agreement with the experimental results and with experience. A.

534.845

4104. THE SOUND ABSORPTION COEFFICIENTS OF (VARIOUS) MATERIALS MEASURED BY THE REVERBERATION METHOD. F.Kolmer.
Slaboproudý Obzor, Vol. 17, No. 9, 500-7 (1956). In Czech.

The coefficients were evaluated from the Eyring formula on the basis of the reverberation time of an empty reverberation chamber and that of the chamber whose walls were partly covered with the measured acoustic material. The reverberation chamber was irregular in shape and had an area of 200.44 m^2 and a volume of 163.46 m^3. Each measurement of the reverberation time was repeated 7 or 8 times. The main work consisted of determining the absorption coefficients as a function of frequency for eight absorption media. The results are illustrated by a large number of graphs. The absorption media were usually in the form of rectangular panels (sometimes rounded or perforated) placed at a distance of 3 cm from the walls; damping materials, such as cotton wool or cloth, were also tried. R.S.Sidorowicz

534.846

4105. ACOUSTICS OF THE ROCHESTER (NEW YORK) WAR MEMORIAL AUDITORIUM. B.Olney and R.S.Anderson.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 94-8 (Jan., 1957).

This arena-type auditorium with a stage at one end has a volume of 3.24 million cubic feet, seats 5774 persons in stationary chairs

and a total of nearly 10 000 with additional, portable chairs. Both the stationary and the portable chairs have upholstered seats. The acoustical hazard of concave rear wall and opposite wall containing the proscenium opening was ameliorated by special treatment. A combination structural-acoustical ceiling was used. The design objective of a reverberation time of about 2.5 seconds in the unoccupied room at 500 c/s was attained without adjustment. The results of reverberation-time measurements are shown and discussed. The public-address system is described and the subjective assessment of the auditorium is mentioned. A.

534.846

4106. ACOUSTICS OF LARGE ORCHESTRAL STUDIOS AND CONCERT HALLS. T.Somerville and C.L.S.Gilford.
Proc. Instn Elect. Engrs, Paper 2297R, publ. March, 1957 (Vol. 104B, 85-97).

In order to establish design criteria for orchestral studios, which should be similar in performance to good concert halls, an extensive investigation has been progress for many years. The effects of shape on the subjective acoustic qualities of a large enclosure are here examined with reference to a large number of concert halls and music studios, and a comparison is made, in particular, between concert halls of the traditional type and those which have been built during the last few decades. The former were generally of rectangular plan with walls and ceilings overlaid with ornamentation, whereas most recent designs have fan-shaped plans, reflecting canopies and comparatively smooth surfaces. Measurements of sound levels in different parts of concert halls during orchestral concerts show that, for a given sound level in the neighbourhood of the platform, the intensity at the back of the hall is no greater in halls with fan-shaped plans and reflectors than with the traditional rectangular shape. In the former case, the gain in the intensity of the first few reflections which results from the shape of the hall is offset by a reduced reverberant sound level. The authors conclude that the modern fashion of directing the early reflections towards the back of a concert hall, although it may improve the hearing of speech, has an adverse effect on the quality of music. A.

OPTICS. RADIATION. SPECTRA 535

535 : 538.56.029.6

4107. DEVELOPMENTS IN OPTICS AND MICROWAVES. J.Brown.
Nature (London), Vol. 179, 24-5 (Jan. 5, 1957).

A short report on a symposium on microwaves and optics held at the Washington (D.C., U.S.A.) University in November 1956. The symposium was arranged jointly by the Institute of Radio Engineers and the Optical Society of America.

535.14

4108. THE QUESTION OF CORRELATION BETWEEN PHOTONS IN COHERENT LIGHT RAYS. R.H.Brown and R.Q.Twiss; E.M.Purcell.
Nature (London), Vol. 178, 1447-8, 1449-50 (Dec. 29, 1956).

Brown and Twiss consider that they have previously experimentally demonstrated that the times of arrival of photons are correlated in two coherent beams of light. This conclusion has been criticized by Brannen and Ferguson. It is shown here that the criticism is invalid. An analysis is given of the expected signal-to-noise ratio and it is concluded that the result obtained by Brannen and Ferguson is to be expected theoretically. Their equipment was too insensitive to detect a significant correlation by at least four orders of magnitude.

Purcell also (independently) analyses signal-to-noise ratio in the experiments of Brannen and Ferguson, comparing those with Brown and Twiss. It is shown first that the Brown–Twiss effect is an instructive illustration of the principles of quantum mechanics. Secondly the counting system of Brannen and Ferguson is shown to be such that counting periods of the order of years would be needed in order to demonstrate the effect, whereas minutes are required by Brown and Twiss. S.Tolansky

535.222

4109. A NEW EFFORT TO MEASURE THE VELOCITY OF LIGHT. R.Gerharz.
J. Electronics, Vol. 2, No. 5, 416-24 (March, 1957).

The value of the group velocity of light in terms of a distance per unit time is explained and a practicable method for its determination is proposed. Principally the apparatus uses a light pulse which originates from the dynodes of an electron multiplier as visible fluorescence radiation emitted by a crystallized surface (MgO) under electron excitation. After travelling through a specified distance, the light pulse becomes reflected by a mirror and triggers electronically a new flash of light upon arrival at the original tube. The number of such occurrences depends on the position of the mirror and can be displayed and measured by a beat frequency method. The displacement of the mirror is measured interferometrically. The entire apparatus and possible sources of error are discussed. A.

535.222.08

4110. CONCERNING THE MEASUREMENT OF VERY SMALL CHANGES IN THE DIFFERENCE OF VELOCITY OF TWO LIGHT WAVES. I.L.Bershteĭn.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 4, 655-8 (1954). In Russian.

A small periodic displacement of one of the mirrors of a Michelson interferometer will produce a periodic variation of the fringe intensity. The equations which describe the resultant intensity variation are written down and it is shown theoretically that if a photocell is used to detect the intensity variation, it is possible to detect displacements of the order of one hundredth to one thousandth of an angstrom unit. Some evidence that this sensitivity can be achieved in practice is quoted. W.Bardsley

535.223

4111. PRECISION DETERMINATION OF THE VELOCITY OF LIGHT DERIVED FROM A BAND SPECTRUM METHOD. III. D.H.Rank, A.H.Guenther, J.N.Shearer and T.A.Wiggins.
J. Opt. Soc. Amer., Vol. 47, No. 2, 148-50 (Feb., 1957).

For Pt II, see Abstr. 8124 (1954). Improved techniques have made it possible to increase the absolute and relative accuracy of wavelength measurements in the near infrared. Thirty lines of the 002-000 band of HCN have been measured and used to determine upper and lower state constants. The values in cm^{-1} are: $B'' = 1.478218$, $B' = 1.457069$, $D'' = 2.913_7 \times 10^{-6}$, $D' = 2.863_7 \times 10^{-6}$, and $\nu_0 = 6519.6135$. These values, when combined with microwave measurements, give for the velocity of light $c = 299\,793.2 \pm 1.8$ km/sec. A.

535.223

4112. ACCURACY OF A MICROWAVE RESONANT CAVITY MEASUREMENT OF THE VELOCITY OF LIGHT. D.H.Janney.
Phys. Rev., Vol. 105, No. 4, 1138-40 (Feb. 15, 1957).

Most of the problems involved in a measurement of the velocity of light by a microwave resonant cavity are discussed briefly on the basis of work reported elsewhere. A more nearly complete theoretical analysis of the effects of the cavity-surface impedance is given. In general, the surface reactance and resistance must both be known to relate the measured resonant frequency to the normal-mode frequency. This problem limits the accuracy of the experiment to an uncertainty of no less than about 2 parts in 10^6. The formal requirements for reducing this uncertainty are stated, but no experiment is suggested. A.

535.241.34

4113. A PRIMARY STANDARD FOR ABSOLUTE SPECTROPHOTOMETRIC MEASUREMENTS. G.F.Sitnik.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 5, 780-2 (1956). In Russian.

The author's standard apparatus consists of a graphite tube source of black body radiation, used at temperatures of 2014-2626° K, a quartz monochromator and photoelectric devices for measuring intensity of radiation. Particulars are described in some detail. Results are used for calibrating electric bulbs, to be employed as secondary standards. R.Eisenschitz

535.247.4

4114. CONSOLE COMPARATOR MICROPHOTOMETER FEATURING HIGH SCREEN INTENSITY AND A NULL-RATIO MEASUREMENT SYSTEM. H.B.Beal, R.K.Brehm and R.F.Jarrell.
J. Opt. Soc. Amer., Vol. 47, No. 4, 306-11 (April, 1957).

An instrument of new design is described. An optical system has been developed in which all of the available light flux is used for both viewing the spectrum and measuring the transmission of selected spectral lines. Besides high viewing screen intensity and great sensitivity, a unique electronic system is employed. The advantages of this null-ratio system include: reduced drift and noise, independence of individual vacuum tube characteristics, and freedom from the logarithmic damping response characteristic of galvanometers and meters. A.

535.247.4

4115. PHOTOMETRY WITH MULTIPLIER PHOTOCELLS. J.M.Naish.
Nature (London), Vol. 179, 269-70 (Feb. 2, 1957).

In measuring, by means of a multiplier photocell, the intensities of punctiform images formed by a lens under test, the effect of variations of sensitivity over the photocathode of the cell may be eliminated or greatly reduced by mounting a sufficiently small aperture (e.g. diam. 2 μ) at a suitable fixed distance in front of the cathode. The response is then very closely proportional to the intensity of the light. J.W.T.Walsh

535.312.3 : 778.37

4116. DEFORMATION OF ROTATING MIRRORS RESULTING FROM CENTRIFUGAL FORCE. T.E.Holland.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1090 (Dec., 1956).

A Foucault knife-edge test has been made on high-speed mirrors used in smear cameras etc. A cylindrical deformation proportional to the speed of rotation exists and can be compensated, except for an end effect, by the use of an auxiliary lens. R.W.Fish

535.315 : 535.42

4117. DIFFRACTION THEORY OF THE IMAGE IN A PRISMATIC SPECTRAL APPARATUS WITH RECTANGULAR APERTURE. K.D.Mielenz.
Optik, Vol. 13, No. 10, 437-62 (Oct., 1956). In German.

Expressions are developed and shown graphically for the intensity distribution in the image, as a function of slit width and the absorption coefficient of the prism material, for the limiting cases of coherent and incoherent illumination. The effect of prism absorption is demonstrated experimentally by photographs of line spectra taken with a hollow prism filled with $KMnO_4$ solutions in different concentrations. The intensity at the centre of the image is determined photographically as a function of slit width and the results compared with theory for the limiting cases of illumination: coherent with small slits and incoherent with large slits. G.F.Lothian

535.317.25 : 771.534.55

4118. TECHNIQUES OF MEASUREMENT OF RESOLVING POWER, DESCRIPTION AND PERFORMANCE OF AN INTERFERENCE RESOLUMETER. L.Falla.
Bull. Soc. Roy. Sci. Liège, Vol. 25, No. 3, 167-82 (March, 1956). In French.

Resolution of a photographic emulsion can be determined (1) by contact printing from a microscopic object, which may be radioactive, or (2) by projection of a reduced image, in which case the resolving power of the objective is important. The disadvantages of these methods are discussed, and it is preferred to photograph a set of monochromatic fringes produced by a slit and a plane mirror. The principles and precision of this method are described, also some details of the apparatus and its adjustment. Photographs show resolved line patterns up to 1000 lines/mm. The same apparatus will determine the resolving power of an objective.
S.T.Henderson

535.317.25

4119. THE INFLUENCE OF CONDENSER APERTURE ON THE RESOLUTION OF A PAIR OF PARALLEL LINES. A.M.Goodbody.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 361-8 (April, 1957).

An expression is found for the distribution of light in the image of two parallel lines which are illuminated by a condenser of numerical aperture equal to σ times that of the imaging objective. The intensity distributions are plotted for various values of σ and of the separation of the lines. The resolving power of the system is written $\xi = K\lambda/N.A.$ and K is plotted as a function of σ. A.

535.317.9

4120. DESIGN OF AN f/2 DOUBLE ASPHERIC CURVED FIELD LENS. J.Meiron.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1091-2 (Dec., 1956).

A nearly symmetrical lens formed by two doublets and two aspherical corrector plates is described. The prescription is given and the calculated aberration residuals are quoted. These are small enough to give a circle of least confusion smaller than 100 μ over a 20° semi-field at a focal length of 10 cm. R.W.Fish

535.323 : 548.7

4121. THE REFRACTION OF LIGHT IN CRYSTALS AND THE ENERGY OF THE BONDS BETWEEN IONS. A.A.Vorob'ev.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 1, 53-4 (1957). In Russian.

Interaction of light with a crystalline dielectric is discussed. Refractive index (n) shows anomalous behaviour near the main absorption edge but at longer wavelengths plots of n against lattice energy for the halides of each alkali metal give a family of smooth parallel curves. Alkaline earth halides show a similar variation, but among their oxides BaO appears to have an unexpectedly high value of n (5.8, determined indirectly from dielectric constant).
C.H.L.Goodman

535.324

4122. REFRACTIVE INDEX OF LIQUIDS AT ELEVATED TEMPERATURES. J.L.Lauer and R.W.King.
Analyt. Chem., Vol. 28, No. 11, 1697-701 (Nov., 1956).

The determination of the refractive index at elevated temperatures using commercially available instruments has been hampered by the lack of reliable calibration standards. Two instruments have been constructed for the absolute determination of the refractive index at elevated temperatures. One instrument is useful for determinations in the temperature range 25° to 55° C, and the other from 60° to 110° C. Data obtained using these instruments are presented for three hydrocarbons prepared as calibration standards and six other hydrocarbons. The air refractive indices of these compounds at 80° and 100° C have been determined for six wavelengths of the visible spectrum. The accuracy with which the Eykman function, $C = (n^2 - 1)/d(n + 0.4)$, represents the relationship between the refractive index and the density has also been investigated for two hydrocarbon liquids from room temperature to 100° C. A.

535.33

4123. PROVISIONAL WAVELENGTH STANDARDS IN THE VACUUM ULTRAVIOLET. II. SPECTRA OF Cu II AND Fe II. P.G.Wilkinson.
J. Opt. Soc. Amer., Vol. 47, No. 2, 182-5 (Feb., 1957).

For previous part see Abstr. 9541 (1955). A critical analysis of the wavelengths of 80 Fe I and Fe II lines (1964 A-1559 A) and 158 Cu II lines (1522 A-862 A) for use as wavelength standards has been made. Using only those lines in each spectrum which can be calculated by the combination principle to ±0.001 A or less and which give a smooth dispersion curve, relative measurements of the remaining lines have been carried out, thus placing all of the spectra on a consistent wavelength scale. It is believed that the revised wavelengths are self-consistent to ±0.0013 A but may contain a systematic error of 0.002 A. Comparison of various multiplet intervals confirms the reliability of these data. A.

535.33.03 : 539.153

MICROWAVE TECHNIQUE FOR DETERMINING THE FINE STRUCTURE OF THE HELIUM ATOM. See Abstr. 3553

535.33.07

4124. INDICATING OF WAVE-NUMBERS IN SPECTROPHOTOMETRIC RECORDING AT HIGH RESOLUTION. B.Å.Krantz and N.Åslund.
Ark. Fys., Vol. 11, Paper 39, 453-64 (1957).

In a previous publication (Abstr. 6503/1956) the authors have described a method for the indication of wavenumber marks at constant intervals on a graphic recording of a spectrum. In the present paper an account is given of the development of the method for application to the precision measurement of spectrum lines, especially iron lines. In the determination of the wavelength of a line by interpolation between two lines of known wavelength a mean error of approximately 6×10^{-4} A has been achieved. The method has been improved by a new way of determining the centre of the interference lines. Also an iron hollow-cathode has been tested and adapted for spectrophotometric measurement. A.

535.331

4125. ISOTOPE SHIFTS IN THE SPECTRA OF STRONTIUM. R.H.Hughes.
Phys. Rev., Vol. 105, No. 4, 1260-1 (Feb. 15, 1957).

The isotope shifts in strontium have been studied in the hollow-cathode spectra from enriched even isotopes with the aid of a Fabry–Perot interferometer. The mass effects show predominance. The field effects are zero within experimental error, with no differential shift between 88-86 and 86-84. The $5p^2\ ^3P$ terms are apparently perturbed to the extent that they exhibit a relatively large specific mass effect. A.

535.332/.333

4126. THE FORBIDDEN O I LINES AND PHOSPHORESCENCE BANDS EMITTED FROM INERT GASES CONTAINING TRACES OF OXYGEN. L.Vegard and G.Kvifte.
Skr. Norske VidenskAkad. Oslo, Kl. I, 1955, No. 2, 20 pp.

Traces of oxygen in argon and other rare gases, when excited by a high frequency electrodeless discharge, give the auroral line at 5577 A. A phosphorescence band is also observed for the case of argon in the same spectral region. This band increases almost linearly in intensity relatively to the 5577 A line as the total gas pressure increases up to 700 mm Hg. The intensities of both line and

band decrease with increasing oxygen concentration over the range used (2 to 70 x 10^{-6}), while the ratio of band to line intensity increases. The structure of the band suggests the vibrational series of a very unstable molecule, with mean wavenumber difference of 17 cm^{-1}. The mechanism of excitation is discussed, and it is concluded that the band arises from the molecule AO. S.T.Henderson

535.332 : 539.132

4127. TRIPLET–QUINTET TRANSITIONS IN THE SPECTRUM OF ATOMIC SILICON. M.A.El'yashevich and O.N.Nikitina.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 2, 325-7 (1956). In Russian.

Two weak lines in the Si spectrum at 3006.72 A (33249.16 cm^{-1} in vacuo) and at 3020.00 A (33102.95 cm^{-1}) are confirmed and assigned to $^5S_2-{}^3P_1$ and $^5S_2-{}^3P_2$ transitions. This places the $^5S_2$ level as the lowest of the valency configuration 3s $3p^3$; it lies 33326.28 cm^{-1} (4.13 eV) above the ground level $3s^2\ 3p^2\ {}^3P_0$. D.H.Whiffen

535.332

4128. CONTINUOUS EMISSION SPECTRUM OF NEON IN THE VACUUM ULTRAVIOLET REGION. Y.Tanaka, A.S.Jursa and F.J.LeBlanc.
J. Opt. Soc. Amer., Vol. 47, No. 1, 105 (Jan., 1957).

Emission continua are reported which extend between 737 and 1050 A. They were observed in high pressure (20-360 mm Hg) discharges through neon: more strongly when condensed than uncondensed. R.W.Nicholls

535.333

4129. VIBRATIONAL ANALYSIS OF THE MOLECULAR SPECTRA OF POLONIUM. G.W.Charles, D.L.Timma, D.J.Hunt and G.Pish.
J. Opt. Soc. Amer., Vol. 47, No. 4, 291-6 (April, 1957).

Measurement of spectrograms of electrodeless discharges in purified polonium has yielded over 450 red-shaded band heads in Po^{210} and more than 500 heads in mixtures of $Po^{208}-Po^{209}$. Approximately 350 of these have been classified in a system concluded to be the principal system of Po–Po with the following constants ($Po^{210}-Po^{210}$):

$T_e' = 25149.3$ K $\quad \omega_e' = 108.532$ K $\quad \omega_e'x_e' = -0.4417$ K
$\omega_e'' = 155.715$ K $\quad \omega_e''x_e'' = -0.3353$ K $\quad \omega_e''y_e'' = -0.0003226$ K.

Observed and calculated isotope shifts are in close agreement. The dissociation energy of the lower state is calculated to be 1.895 V under the assumption that the dissociation products are normal polonium atoms. A.

535.333 : 537.523.3

4130. AN INVESTIGATION OF THE PHOTOELECTRICALLY ACTIVE U.V. LIGHT FROM H_2 AND O_2 CORONA DISCHARGES. W.Bemerl and H.Fetz.
Z. angew. Phys., Vol. 8, No. 9, 424-9 (Sept., 1956). In German.

Describes the study of radiation emitted from wire-cylinder corona discharges, using gas absorption and/or photoemission from a copper electrode as a measure of the radiation. The absorbable light from O_2 corona showed several absorption peaks (marked inhomogeneity in the emission spectrum), in contrast with the H_2 results. J.D.Craggs

535.333 : 537.523.3

4131. THE EXTREME SHORT WAVELENGTH U.V. LIGHT OF A NOBLE-GAS DISCHARGE. W.Bermel and H.Fetz.
Naturwissenschaften, Vol. 43, No. 12, 272-3 (1956). In German.

Experimental study of the intensity, and the absorption in the same gas of short wavelength radiation from corona discharges between coaxial cylinders, using an apparatus previously described (preceding abstract). The gases used were He, Ne and A at pressures between 0.1 and 500 mm Hg. It is concluded that at the higher pressures in He the emission arises from the continuum of He_2, and this is confirmed spectroscopically. J.Dutton

535.333

4132. THE $B^2\Sigma^+-A^2\Sigma^+$ BAND-SYSTEMS OF OH AND OD. R.F Barrow.
Ark. Fys., Vol. 11, Paper 19, 281-90 (1956).

Detailed analysis of the bands discovered by Schüler and Woeldike (Physikalische Zeitschrift, Vol. 44, 435, 1943) confirms the view that they arise from a transition $B^2\Sigma^+-A^2\Sigma^+$ in OH. Values of the constants for the state $B^2\Sigma^+$ are:

	T_e	ω_e	B_e	r_e
OH	69 775	940	5.54	1.80 A
OD	69 790	684	2.91	

The dissociation energy of the hydroxyl radical, $D_0''(OH)$, is found to be $101.3_3 \pm 0.3$ kcal. The positions of bands in the expected system $B^2\Sigma^+-X^2\Pi$ of OH are predicted. Other ultraviolet bands are briefly discussed. A.

535.333

4133. SPECTRUM OF THE C_3 MOLECULE BETWEEN 3600 Å AND 4200 Å. N.H.Kiess and H.P.Broida.
Canad. J. Phys., Vol. 34, No. 12B, 1471-9 (Dec., 1956).

C_3 bands have been observed in the emission spectrum of an acetylene–oxygen flame with an excess of acetylene. In addition to the usually observed bands of the 4050 A group, weak bands at wavelengths less than 4000 A and greater than 4100 A have been observed. Measured wavelengths are given of 40 band-heads superimposed on a strong continuum, extending from 3600 to 4200 A. A rotational analysis of the two strongest bands with heads at 4050 A and 4072 A is given also. The relative simplicity of these two bands indicates that the complexity of the other C_3 bands is caused by lines of overlapping bands. A.

535.333

4134. THE ROTATIONAL ANALYSIS OF THE SINGLET SYSTEM B OF ZIRCONIUM OXIDE. THE λ 8192 BAND-SYSTEM. L.Åkerlind.
Ark. Fys., Vol. 11, Paper 31, 395-404 (1956).

A rotational analysis of the green singlet band-system B of zirconium oxide has been carried out. It has no connection with the singlet system A, as is suggested by the agreement of the vibrational constants. The 0,0 and 1,0 bands have been analysed. Besides the main lines belonging to the molecule $Zr^{90}O^{16}$, also isotope lines ($Zr^{91}O^{16}$, $Zr^{92}O^{16}$, $Zr^{94}O^{16}$) have been identified. The rotational constants of the main isotope are: $B_0'' = 0.4167$ K, $\alpha_{cal.} = 0.0012$ K, $D_0'' = 0.35 \times 10^{-6}$ K, $B_v' = 0.3986 - 0.0021(v' + \frac{1}{2})$ K, $D_\delta = 0.37 \times 10^{-8}$ K; $D_1' = 0.39 \times 10^{-6}$ K, $r_e'' = 1.725 \times 10^{-8}$ cm, $r_e' = 1.764 \times 10^{-8}$ cm. System B is regarded as a $^1\Sigma-{}^1\Sigma$ or a $^1\Delta-{}^1\Delta$ transition. Its upper and lower states are called d and c respectively. Finally, the group of ZrO bands round 8192 A is shortly discussed.

535.337 : 538.615 : 548.7

4135. LINEAR AND QUADRATIC ZEEMAN EFFECTS AND THE DIAMAGNETISM OF THE EXCITON OF A CRYSTAL OF CUPROUS OXIDE. E.F.Gross and B.P.Zakharchenya.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 3, 564-7 (1956). In Russian.

With thin films of Cu_2O at the temperature of liquid N_2 two series of absorption lines, one in the green and one in the yellow, were observed. Expressions are given for the two series. The behaviour of the lines when the temperature is taken down to 1.3° K shows that effects due to the highly excited states may be accounted for satisfactorily by the Mott model. Experiments were also done on the effect of a magnetic field on the lines of a Cu_2O film. Zeeman splitting was observed. It was also noted that the lines do not have a centre of gravity at the normal (unmagnetized) line position but there is a shift in the short wavelength direction and this shift is proportional to H^2 (photographs). The diamagnetic shift in the exciton spectrum enables the exciton radius to be determined. C.R.S.Manders

535.337 : 537.228.5

4136. STARK-SPLITTING IN CRYSTALS. W.A.Runciman.
Phil. Mag. (Eighth Ser.), Vol. 1, 1075-7 (Nov., 1956).

The number of levels is tabulated for integral values of J from 0 to 8, and for fields of (1) cubic, (2) hexagonal, (3) tetragonal, and (4) lower symmetry. With half-integral values of J from $\frac{1}{2}$ to 17/2 the levels are given for (1) cubic, and (2) all other groups. General rules connecting the terms in each series are stated. S.T.Henderson

535.338.32

4137. A NEW FORM OF THE DOUBLE RESONANCE METHOD. H.Bucka.
Naturwissenschaften, Vol. 43, No. 16, 371 (1956). In German.

A modification of Brossel and Kastler's method (see Abstr. 2334/1950) for the investigation of the h.f.s. of excited atomic states which cannot be separated by interferometric methods. The principle is again to produce a deviation from the equilibrium values of the occupation numbers of the various terms, but, instead of using polarized light, the deviation is produced by the h.f.s. of the excit non-polarized line. There is then a different self-absorption of t various h.f.s. components of the resonance line, which allows de tection of the high-frequency forced transitions. The method wa applied with success to the 7 $P_{\frac{1}{2}}$-term of Cs^{133}. L.Pinc

535.

4138. FINE STRUCTURE AND LAMB SHIFT OF THE $2s_{1/}$ LEVEL IN THE T_α LINE OF TRITIUM λ 6560 A. P.S.Kireev
Dokl. Akad. Nauk SSSR, Vol. 112, No. 1, 41-4 (1957). In Russia

Tritium is suitable for measurements of Lamb shifts beca of the smaller Doppler widths and using 2 mm of Hg of tritium

in a high frequency discharge tube at liquid N_2 temperatures the line structure of the 6560 A transition was partly resolved with a 7.0 mm Fabry–Perot etalon. Three lines, a/e/g, of intensity ratios 1.000/0.772/0.218 are assigned to the transitions (a) $3d_{5/2}-2p_{3/2}$ (e) $3p_{1/2}-2s_{1/2}$ and (g) $3d_{3/2}-2p_{1/2}$ with the intervals a–e 0.1923 and e–g 0.1290 cm^{-1}; the weaker transitions are not resolved. The $2s_{1/2}-2p_{1/2}$ shift is 0.0355 ± 0.003 cm^{-1} compared with the theoretical 0.037. The shift from the H_α-line is 5.5305 ± 0.0025 cm^{-1} which is 0.006 cm^{-1} greater than that calculated from the mass effect alone. D.H.Whiffen

535.338.333

4139. SOME RESULTS OF AN INVESTIGATION OF THE ISOTOPE SHIFT IN THE SPECTRUM OF NEODYMIUM. F.A.Korolev and Yu.I.Osipov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 3, 365-7 (1956). In Russian.

Isotope shift was investigated in the region 4450 to 6500 A using the natural mixture of isotopes of neodymium. Most lines decomposed into 3 to 6 components. Spacings, $\delta\bar{\nu}$, between components corresponding to the first four even isotopes of Nd are approximately equal, and decrease with increasing wavelength. The spacing between components Nd^{148} and Nd^{150}, $\delta\bar{\nu}_{an}$, was measured on lines in the spectral region 5291 to 6485 A. The ratio $\delta\bar{\nu}_{an}/\delta\bar{\nu}$ is lower for the red than for the blue-violet end of the spectrum. For the lines 6310.4 and 6070.2 A $\delta\bar{\nu}_{an}/\delta\bar{\nu}$ is nearly equal to 1. Z.Krasucki

535.338.334 : 531.711

4140. EFFECT OF CHANGE OF ARGON PRESSURE IN AN ELECTRODELESS DISCHARGE UPON THE REPRODUCTION OF WAVELENGTH OF THE Cd^{114} RED LINE. N.R.Batarchukova and G.B.Dubrovskiĭ.
Optika i Spektrosk., Vol. 1, No. 3, 330-3 (1956). In Russian.

A spectrum line used as a standard of length should be symmetrical in form and stable to ensure reproducibility and it should have no hyperfine structure. The Kr^{84} line has been shown to give a shift in its maximum line under change of pressure. Present authors set out to determine the shift and broadening of the Cd^{114} line, with change of argon pressure, in an electrodeless discharge. A Fabry–Perot type interferometer was used set up between the collimator and prisms of a Frish spectrograph. On a length of film photographs were taken of the Cd spectrum over a range of some 40 pressures ranging from 1 to 48 mm Hg. A graph of shift v. pressure (roughly linear) is given with an expression for its calculation. C.R.S.Manders

535.338.334 : 535.352

4141. BROADENING OF SPECTRUM LINES DUE TO COLLISIONS WITH ELECTRONS. I.I.Sobel'man.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 519-20 (1956). In Russian.

A number of recent papers by Kivel, Bloom and Margenau (Abstr. 5311, 5995, 7833/1955) have dealt with broadening of lines by electrons and attempted to solve the problem making no assumptions regarding the actual mechanism of broadening. Owing to computational difficulties the Born approximation had to be used in conditions where its applicability is in doubt. The present author's calculations show that collision-broadening of lines due to electrons has a dispersion character. A relatively simple expression is obtained for effective transverse broadening and it is shown that this and certain other general formulae derived by the author in the Born approximation give the results of Kivel, Bloom and Margenau. C.R.S.Manders

535.338.334 : 537.523.5

4142. FORM AND WIDTH OF SPECTRAL LINES IN A D.C. ARC. V.F.Kitaeva and N.N.Sobolev.
Optika i Spektrosk., Vol. 1, No. 3, 302-20 (1956). In Russian.

A Fabry–Perot etalon was used to study the form and breadth of spectral lines [Na: 5890 A (main series); 6160.7, 5153.4, 4751.8 A (sharp series); 8194.8, 5688.2, 4982.8 A (diffuse series), and Tl: 5350 A] with transverse Stark effect in a d.c. electric arc. Experimental results are compared with those of impact and statis-al theories of broadening of spectrum lines. For a constant der Waals force and constant Stark effect ($c_4 < 3 \times 10^{-14}$) it is n that the form of the line is symmetrical and determined by sions of radiating atoms with air molecules and by Doppler for Na λ = 5890 A and Tl λ = 5350 A. Similarly for the lines nd 8194.8 A with constant Van der Waals forces and trans-rk effect ($3 \times 10^{-14} < c_4 < 1 \times 10^{-13}$) results are symmetri-determined by collisions of radiating atoms with air mole-nd electrons and by Doppler effect. When $c_4 > 1 \times 10^{-13}$ the re unsymmetrical and there is statistical broadening an t of the plasma ions of the arc. C.R.S.Manders

535.34.07 : 536.581.3

4143. CRYOSTAT FOR SPECTROPHOTOMETRIC MEASUREMENTS. T.O.Jones and J.E.Willard.
Rev. sci. Instrum., Vol. 27, No. 12, 1037-9 (Dec., 1956).

A cryostat is described which will maintain optical cells at any temperature from −190° C to 0° C while they are being scanned in a recording spectrophotometer. Liquid air is used as the refrigerant and the temperature is adjusted by means of an electrical resistance heater. Fogging of the optical system is avoided by circulation of the dry refrigerant vapours and by window heaters. A.

535.34.07 : 530.145

GEOMETRICAL REPRESENTATION OF THE SCHRÖDINGER EQUATION FOR SOLVING MASER PROBLEMS. See Abstr. 3981

535.34.07

4144. CONVERSION OF AN INFRARED SPECTROPHOTOMETER INCORPORATING A MEMORY SYSTEM TO DOUBLE BEAM OPERATION. K.M.M.Kruse.
Rev. sci. Instrum., Vol. 28, No. 1, 40-2 (Jan., 1957).

The conversion of a Beckman IR2-T infrared spectrophotometer to double beam operation, using as many units of the original instrument as possible, is described. The Brown recorder incorporated in the original system is used as a ratio recorder by applying the reference signal to the slide wire input. A compensation method for signal intermodulation, previously not used in similar systems, is described and some technical difficulties are pointed out. A.

535.343

4145. ABSORPTION BANDS OF RUBIDIUM IN THE PRESENCE OF HYDROCARBONS. S.-Y.Ch'en and O.Jefimenko.
J. chem. Phys., Vol. 26, No. 2, 256-62 (Feb., 1957).

Absorption spectra of rubidium in the presence of fourteen different hydrocarbons (methane, ethane, propane, n-butane, n-pentane, n-hexane, n-heptane, n-octane, n-decane, n-dodecane, cyclopropane, butene-2 and benzene) were studied. About one hundred new rubidium–hydrocarbon absorption bands associated with the first four members of the Rb principal series were observed. Some regularities in the occurrence of the bands were found. The positions of the bands are given and the properties of the bands are discussed. A.

535.343

4146. OPTICAL PROPERTIES OF URANIUM HEXAFLUORIDE. I. ABSORPTION SPECTRA IN THE VISIBLE AND NEAR ULTRAVIOLET REGIONS. G.D.Sheremet'ev.
Optika i Spektrosk., Vol. 1, No. 2, 181-9 (1956). In Russian.

The paper includes results obtained by the author in 1948-50. A laboratory vacuum distillation method was developed for the purification of UF_6 from volatile impurities. It was possible in this way to obtain crystals of greater transparency. Photographs are given of absorption spectra of UF_6 in the vapour, solid and molten states for the visible and near ultraviolet regions. It is established that for UF_6 vapour the electron oscillatory structure of the 4070-3470 A band breaks down into 15 separate groups of narrow bands; a similar result is obtained for the solid from room temperature down to 88° K. With molten UF_6 at 353° K no such fine structure was discovered. C.R.S.Manders

535.343 : 548.7

4147. VARIATIONS IN THE ULTRA-VIOLET ABSORPTION OF COUNTING DIAMONDS. F.C.Champion and D.L.O.Humphreys.
Proc. Phys. Soc. B., Vol. 70, Pt 3, 320-5 (March, 1957).

Using a photomultiplier, the ultraviolet absorption of about fifty small octahedral diamonds has been examined. Correlation has been established between counting efficiency and freedom from ultraviolet absorption at various characteristic wavelengths, and the results are tentatively explained in terms of probable defects present in the diamonds. A.

535.343

4148. ELECTRONIC SPECTRA OF MONO-, DI- AND TRIAZINES OF THE NAPHTHALENE SERIES. I. BENZOTRIAZINE AND ITS DERIVATIVES. M.Simonetta, G.Favini, S.Carrà and V.Pierpaoli.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1364-83 (Dec., 1956).

The visible and near ultraviolet spectra of 1,2,4-benzotriazine and some of its derivatives have been obtained in cyclohexane and in methanol. Bands are assigned to $n \rightarrow \pi^*$ and $\pi \rightarrow \pi^*$ electron transitions, and for $\pi \rightarrow \pi^*$ bands in benzotriazine and pyridazine a theoretical treatment is given by the standard of L.C.A.O. molecular orbital method and by Pariser and Parr's semi-empirical method. A.

535.343

4149. MEASUREMENTS OF SELF-BROADENING IN HCN. M.T.Pigott and D.H.Rank.
J. chem. Phys., Vol. 26, No. 2, 384-90 (Feb., 1957).

A high-resolution directly recording grating spectrometer has been used to measure the line breadths of absorption lines in both the P and R branches of the 002 band of HCN. The observed line breadths, corrected for Doppler and instrument broadening, indicate that the earliest classical theory of Lindholm predicts the correct J dependence of pressure broadening between J = 0 and J = 25. The observed pressure broadening appears to be sensibly independent of J for J = 27 to J = 34. Hence the lines fail to become extremely narrow as J gets large, the line narrowing being a phenomenon required by existing theories which consider only J-dependent terms. The high J half-width, 0.0055 cm^{-1}/cm Hg, is nearly equal to the term which must be added to Lindholm's earliest classical expression to bring it into agreement with observations at the band maximum. Present measurements agree well with the J = 0 to J = 1 microwave measurement by Smith et al. and also with the uncorrected line breadths measured at 580 mm Hg by Lindholm. A.

535.343 : 541.135

4150. SYMMETRIES OF ELECTRIC FIELDS ABOUT IONS IN SOLUTIONS. ABSORPTION AND FLUORESCENCE SPECTRA OF EUROPIC CHLORIDE IN WATER, METHANOL, AND ETHANOL. E.V.Sayre, D.G.Miller and S.Freed.
J. chem. Phys., Vol. 26, No. 1, 109-13 (Jan., 1957).

The theoretical and experimental correlations between the symmetries of the microfields about ions, the degree of splitting of energy levels, and the selection rules for radiation have been so successful for ions in crystals that the extension of this approach to discover the precise point symmetries about ions in solutions appears limited only by instances where the spectra of the solutions are sufficiently discrete. The spectra of crystals containing a rare earth ion in known local symmetry furnish the quantum characters of the energy levels and then the numbers of lines in the respective transitions of the ions in solutions lead to the symmetries of the fields about the dissolved ions. Salts of europium which are regarded as strong electrolytes exhibit sufficiently sharp absorption spectra in solutions at room temperature while their fluorescence spectra become adequately discrete at the temperature of dry ice. The absorption spectrum of europic chloride in water proved to be the same as in a mixture of water and alcohol. The latter solutions furnished the fluorescence spectra at the temperature of dry ice. Fluorescence spectra of the alcoholic solutions in the form of glasses were obtained at 77°K and 4°K. The symmetry of the microfields about the europium ions in the anhydrous alcohols was C_{2v} while that about the ions in aqueous solutions was D_{2h}. A.

535.343

4151. INFRARED SPECTRA OF THE ALKALI HALIDES. I. LITHIUM HALIDES. W.Klemperer and S.A.Rice.
J. chem. Phys., Vol. 26, No. 3, 618-24 (March, 1957).

The infrared spectra of LiI, LiBr and LiCl in the gas phase have been measured in the region of the fundamental vibration frequency. The vibrational frequencies are calculated from the observed spectra to be: LiI ω_e = 501 cm^{-1}; LiBr ω_e = 576 cm^{-1}; LiCl ω_e = 662 cm^{-1}. There is no evidence in the spectra for the existence of appreciable quantities of dimeric molecules, the estimated dimer concentration being thus restricted to less than 15%. The apparatus used appears suitable for absorption measurements above 2000° C. A.

535.343

4152. INFRARED SPECTRUM OF CARBONYL SULFIDE. H.C.Allen, Jr, E.K.Plyler and L.R.Blaine.
J. chem. Phys., Vol. 26, No. 2, 400-3 (Feb., 1957).

Fourteen bands of carbonyl sulphide have been observed between 1 and 5.5 μ. The rotational fine structure of the bands has been analysed and the values of the molecular constants determined. From the average ΔF_2 values of the 8 best bands, $B_0 = 0.202\,88 \pm \pm 0.000\,02$ cm^{-1} and $D_0 = (4.08 \pm 0.52) \times 10^{-8}$ cm^{-1}, in excellent agreement with the microwave determinations. Several constants in the quadratic expression expression for the vibrational energy are evaluated, but Fermi resonance between levels of the type (v_1, v_2^1, v_3) and $(v_1 - 1, v_2^1 + 2, v_3)$ rule out a complete determination from the presently available bands. It is shown that the previously suggested Fermi resonance between ν_3 and $4\nu_2^0$ is so small that it is not detected in this work. A.

535.343

4153. INFRARED-ABSORPTION STUDIES ON BARIUM TITANATE AND RELATED MATERIALS. J.T.Last.
Phys. Rev., Vol. 105, No. 6, 1740-50 (March 15, 1957).

The infrared absorption spectrum of $BaTiO_3$ has been measured for thin single crystals and for powder samples dispersed in pressed KBr disks. Absorption bands for single-crystal samples occur at 495 cm^{-1} and at about 340 cm^{-1}, arising from normal vibrations of the TiO_3 group. A third vibration, a motion of Ba against the TiO_3 group, occurs below the experimentally accessible range. A frequency of about 225 cm^{-1} is expected for this vibration on the basis of a comparison of the specific heat contributions of the observed bands with the measured low-temperature specific heat. Measurements were made on the 495 cm^{-1} band over a wide temperature range. As the crystal changes from the cubic to the tetragonal, orthorhombic, and rhombohedral structures, there occurs band splitting which can be related to the change of crystal symmetry. The spectra of the perovskite titanates, $SrTiO_3$, $PbTiO_3$ and $CaTiO_3$, and the perovskite niobates, $KNbO_3$ and $NaNbO_3$, have been found to be similar, in general features, to that of $BaTiO_3$. The slight differences in band frequency and structure can be related to differences in unit-cell size and symmetry. Integrated band intensities have been found to be in reasonable agreement with measurements on other oxide systems that have vibrations in this spectral region. A.

535.343 : 539.132

4154. DEPENDENCE OF QUADRUPOLE COUPLING CONSTANT ON THE VIBRATIONAL STATE IN ICN MOLECULE. T.Oka, H.Hirakawa and A.Miyahara.
J. Phys. Soc. Japan, Vol. 12, No. 1, 39-42 (Jan., 1957).

The microwave spectrum of the hyperfine components of the $J = 1 \leftarrow 0$ and $J = 2 \leftarrow 1$ rotational transitions of ICN molecule has been measured and the dependence of quadrupole coupling constant on the vibrational state was found. The values of $(eqQ)_I$ for each vibrational state are as follows:

Vibrational states	$(eqQ)_I$ in Mc/s from the frequencies of the $J = 1 \leftarrow 0$ transition	$(eqQ)_I$ in Mc/s from the frequencies of the $J = 2 \leftarrow 1$ transition
(0, 0, 0)	−2418.8 ± 0.5	−2420.1 ± 0.3
(1, 0, 0)	−2426.8 ± 0.7	−2425.1 ± 0.5
(0, 2, 0)	−2403.3 ± 0.8	−2403.1 ± 0.5

The difference in the $(eqQ)_I$ value for the (0, 2, 0) state from that for the (0, 0, 0) state, previously explained by Javan for the (0, 1, 0) state, was confirmed, though the numerical values are slightly different from Javan's. The change of $(eqQ)_I$ due to the excitation of the stretching vibration was also found and was explained in terms of the change of the double bond character of I—C bond. A.

535.343

4155. THE MICROWAVE SPECTRUM OF HDSe. V.G.Veselago and A.M.Prokhorov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 731 (1956). In Russian.

The microwave transitions of HDSe $4_{31} - 4_{32}$, $2_{20} - 2_{21}$ and $9_{54} - 9_{55}$ were observed at 8771.05, 9138.55 and 13862.65 respectively for Se^{80} and at neighbouring frequencies for the other isotopes. D.H.Whiffen

535.343 : 539.133

4156. MICROWAVE SPECTRUM OF VINYLIDENE CHLORIDE. S.Sekino and T.Nishikawa.
J. Phys. Soc. Japan, Vol. 12, No. 1, 43-8 (Jan., 1957).

The microwave spectrum of vinylidene chloride has been observed and analysed. The molecular parameters have been determined to be d_{CCl} = 1.727 A and ∠Cl-C-C = 123° 10' on the assumption of d_{CC} = 1.32 A, d_{CH} = 1.07 A and ∠H-C-C = 120°. The quadrupole coupling constant along the bond direction has been found to be −78.7 Mc/s together with the asymmetry parameter η = 0.12, for Cl^{35}. The five per cent double bond character of C—Cl bond estimated from the quadrupole data is consistent with the value of six per cent estimated from the bond length. A.

535.345

4157. REMARK ON THE ABSORPTION SPECTRA OF RED HgI. M.Sieskind.
J. Phys. Radium, Vol. 17, No. 8-9, 821 (Aug.-Sept., 1956). In French.

535.345

4158. INDUCED TRANSMISSION IN ABSORBING FILMS APPLIED TO BAND PASS FILTER DESIGN. P.H.Berning and A.F.Turner.
J. Opt. Soc. Amer., Vol. 47, No. 3, 230-9 (March, 1957).

The potential transmittance of a given absorbing film depends only on the load admittance of the optical structure with which it is backed, in addition to the optical parameters of the film itself. Utilizing appropriately designed backings of nonabsorbing multilayer films, admittances for light of a specified wavelength can be obtain-

ed which greatly increase the potential transmittance of certain materials, notably metals with high k/n ratios. A high transmittance of the specified monochromatic radiation results if the given film plus backing is subsequently antireflected by a second nonabsorbing multilayer combination added on the side of incidence. This procedure introduces the basic principles of "induced transmission". These principles are applied directly to the problem of improving the efficiency of metal band-pass filters. The resulting designs are discussed from different points of view. A.

535.345

4159. OPTICAL ABSORPTION BAND EDGE IN ANISOTROPIC CRYSTALS. G.Dresselhaus.
Phys. Rev., Vol. 105, No. 1, 135-8 (Jan. 1, 1957).

The shape of the optical absorption band edge in insulating crystals is discussed for both direct and indirect electronic transitions. Selection rules are invoked to explain the apparent shift in the band edge with polarization observed in anisotropic crystals. The absorption coefficient obeys a law of the form $K \propto (\hbar\omega - E)^n$, where E is closely related to the minimum band gap and n is $\frac{1}{2}$ for allowed direct transitions, $\frac{3}{2}$ for forbidden direct transitions, and 2 for indirect transitions. The experimental observations of the shift in CdS and Te are analysed in terms of conduction and valence band extrema at k = 0 with symmetry types such that the transition is allowed for light polarization perpendicular to the hexagonal axis and forbidden for the polarization parallel to this axis. A.

535.345 : 537.531

4160. ULTRAVIOLET ABSORPTION AND DOUBLE X-RAY REFLECTIONS IN DIAMOND. B.S.Fraenkel, A.Halperin and E.Alexander.
Phys. Rev., Vol. 105, No. 5, 1486-7 (March 1, 1957).

Strong correlation is shown to exist between the type of diamond as classified according to absorption in the ultraviolet, and the intensities of double X-ray reflections. The experimental results seem to imply that the mosaic blocks of Type II diamonds are bigger, but less aligned than those of Type I diamonds. A.

535.345 : 537.312.5

OPTICAL AND ELECTRICAL PROPERTIES OF SILVER CHLORIDE. See Abstr. 3297

535.347 : 535.58

4161. ACCESSORIES FOR MEASURING CIRCULAR DICHROISM AND ROTATORY DISPERSION WITH A SPECTROPHOTOMETER. S.Mitchell.
J. sci. Instrum., Vol. 34, No. 3, 89-90 (March, 1957).

Cotton effect studies require data on absorption, circular dichroism and optical rotation, and it is convenient to obtain them all with the same instrument. The apparatus described makes this possible over the wavelength range 3500 to 10 000 A. A.

535.37

4162. A FLASH-LIKE BURST OF LUMINESCENCE IN ZINC SULPHIDE PHOSPHORS, AND THE TWO-STEP MECHANISM OF ITS STIMULATION. N.A.Tolstoĭ.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 3, 582-4 (1956). In Russian.

Many ZnS phosphors after prolonged exposure to constant 365 mμ excitation luminesce with intensity I_∞, but after excitation is stopped for time t and then restored show a burst of luminescence of intensity $I > I_\infty$. I/I_∞ has a maximum value, almost independent of excitation intensity, for $t = t_{max}$. The value of $1/t_{max}$ is found to vary as $\exp(-1/T)$. I/I_∞ can be as much as 6 [for ZnS(Ni)]. The effect is interpreted in terms of serially operative trapping centres, electrons being excited to the luminescent centres (L) via source and flash-generating centres (S and F). On interruption of excitation electrons from S fall to F, filling the latter above the previous (constant excitation) level, so that subsequent excitation can transfer a larger-than-steady-state number of electrons to L. Infrared background radiation was found to affect the process in a manner consistent with this mechanism. Similar effects have been observed in $Cd_2P_2O_7$(Mn + Pb) and TlCl phosphors. C.H.L.Goodman

535.37

4163. SENSITIZATION OF PHOTOLUMINESCENCE BY A SOLVENT. T.P.Belikova and M.D.Galanin.
Optika i Spektrosk., Vol. 1, No. 2, 168-74 (1956). In Russian.

A transfer of excitation energy to the impurity luminescent substance is observed when the photoluminescence of solutions of terphenyl in xylol and of anthracene in toluol is excited by light absorbed in the solvent. Measurements were made of the absorption and luminescent spectra of the solvents, also of the absorption spectra of the solutions. The spectra of the respective luminophors were obtained from the differences of the absorption spectra of solutions and solvents. If it is assumed that the transfer of energy to the impurity substance is due to re-absorption of the light emitted by the solvent then it is found that the transfer probability is greater than that to be expected by resonance transfer. It is suggested that there is transfer due to diffusion of molecules during the period of the excited state. C.R.S.Manders

535.37 : 548.7

4164. LUMINESCENCE OF COLOUR CENTRES IN CsI–Tl CRYSTALS. Z.L.Morgenshtern and I.P.Shchukin.
Optika i Spektrosk., Vol. 1, No. 2, 190-7 (1956). In Russian.

Activation capture centres associated with Ag, Cu, Pb are well known. This paper adds Tl to the list by a tolerably complete study of the luminescent behaviour of CsI–Tl. When a crystal, coloured by the action of X-radiation or γ-rays, is heated the colour disappears and there is thermoluminescence with peaks at 63° and 125°C. It is concluded that the colour centres are electron capture centres which include the two Tl ions in neighbouring cation junctions. C.R.S.Manders

535.37

4165. THE EFFECT OF NON-ACTIVATING Ca^{++} AND Sr^{++} IONS ON THE THERMAL LUMINESCENCE OF X-RAY IRRADIATED NaCl–Ag PHOSPHORS. M.L.Kats.
Optika i Spectrosk., Vol. 1, No. 2, 198-203 (1956). In Russian.

It is shown that introduction of alkali-earth metal impurities into these phosphors gives new peaks, characteristic of the impurity, in the thermal luminosity curves. Ions of the alkali-earth metals introduced into NaCl crystals facilitate stabilization of products of photochemical decomposition. This stabilization is the main reason for increase of storage capacity of NaCl–Ag phosphors which contain non-activating Ca or Sr impurity. C.R.S.Manders

535.37

4166. TWO RECOMBINATION MECHANISMS OF THE LUMINESCENCE OF Sm^{+++} ION IN THE PHOSPHOR ZnS–Sm,Cu(NaCl). V.V.Antonov-Romanovskiĭ and Z.A.Trapeznikova.
Optika i Spektrosk., Vol. 1, No. 2, 204-15 (1956). In Russian.

Two groups of luminescence spectrum lines occur in this phosphor, the kinetics of which differ. One group behaves similarly to the green Cu band and presumably arises from the recombination of thermal electrons. Reasons are summarized why the second group is not associated with optical electrons but in fact arises from recombination of a "hole" with a luminescence centre, due to Sm^{+++}, on which an electron has localized. C.R.S.Manders

535.37

4167. DEPENDENCE OF THE LUMINESCENCE OUTPUT OF THE PHOSPHOR ZnS–Cu ON THE WAVELENGTH OF THE EXCITING LIGHT. M.N.Alentsev.
Optika i Spektrosk., Vol. 1, No. 2, 240-7 (1956). In Russian.

The variation of quantum output of recombination luminescence of the phosphors ZnS and ZnS–Cu with wavelength of exciting light was measured taking account of factors which promote this luminescence or which lower output in the usual measurements. Output during the absorption of exciting light in the main substance is found to be considerably smaller than with absorption of exciting light by luminescence centres. This points to losses during transfer of excitation energy from the main substance to the centres. The variation of luminescence output with wavelength of exciting light for the phosphor ZnS–Cu, is explained by assuming that centres of blue luminescence transmit the energy absorbed by them to the copper centres exceedingly effectively. C.R.S.Manders

535.37

4168. QUENCHING OF THE PHOSPHORS ZnS–Cu,Co AND ZnS–Cu,Ni BY INFRARED LIGHT. L.A.Vinokurov and M.V.Fok (Fock).
Optika i Spektrosk., Vol. 1, No. 2, 248-54 (1956). In Russian.

Since the decay of the afterglow of these phosphors under the action of infrared light is hyperbolic instead of exponential the quenching action of the infrared must be external. A theoretical formula is derived for the variation of brightness of the phosphor with respect to the intensity of the exciting light. An explanation is offered for the killer action of Co and Ni in these phosphors. C.R.S.Manders

535.37

4169. FLASH OUTBURST [OF LUMINESCENCE] OF THE PHOSPHOR ZnS–Ni. N.A.Tolstoĭ.
Optika i Spektrosk., Vol. 1, No. 2, 271-2 (1956). In Russian.

The author and P.P.Feofilov drew attention to this kind of burst of luminescence in 1949 (Dokl. Akad. Nauk SSSR, Vol. 68, 225,

1949). The present paper describes some results obtained with ZnS—Ni provided by A.A.Bundel', which gives strong bursts of illumination in the long-wave band far exceeding in intensity those of ZnS—Mn. Contents of Ni employed were 10^{-7}, 10^{-6}, 5×10^{-6}, 10^{-5} g/g. Afterglow persistence exceeded 24 hours at room temperature. It is suggested that the bursts of luminescence of this type may be a much more widespread phenomenon than it has appeared up to now. C.R.S.Manders

535.37

4170. ZINC OXIDE IN ZINC SULPHIDE PHOSPHOR. A.A.Cherepnev.
Optika i Spektrosk., Vol. 1, No. 2, 272-4 (1956). In Russian.

On the subject of the part played by oxygen compounds in the ZnS luminophor system there has been a considerable amount of work done and the author here discusses it critically. The partial volatilization of components (e.g. Zn, SO_2, S) which occurs during their mutual interaction suggests the formation of defects in the crystal lattice which aid the development of luminescent properties by creating places for the activator and for electron capture. C.R.S.Manders

535.37 : 548.7

4171. LUMINESCENCE OF DECORATED DISLOCATIONS. W.Van der Vorst and W.Dekeyser.
Phil. Mag. (Eighth Ser.), Vol. 1, No. 9, 882-4 (Sept. 1956).

NaCl crystals containing substitutionally dissolved AgCl were deformed and then annealed in hydrogen. Silver ions were reduced by the hydrogen and, on cooling, the dislocations in the crystals became decorated with colloidal silver. On irradiation with X-rays it was found that the blue luminescence, normal for NaCl-Ag, appeared to come more intensely from the regions where the decorated dislocations were located. A.B.Lidiard

535.371

4172. ORIGIN OF THE PHOSPHORESCENCE OF SHORT DURATION OF THE MOLECULE N_2. L.Herman, A.Salmona and G.Lucas.
C.R. Acad. Sci. (Paris), Vol. 243, No. 15, 1029-32 (Oct. 8, 1956). In French.

The phosphorescence of N_2 of short duration, i.e. approximately 10^{-4} sec, has been studied by observation of the emission spectrum in the visible and near ultraviolet. The measured intensities of the systems $C^3\Pi - B^3\Pi$ and $B^3\Pi - A^3\Sigma$ are compared with the intensities calculated in the case of both direct and indirect radiative recombination. Satisfactory agreement is obtained. G.I.W.Llewelyn

535.371

4173. TRAPS IN ORGANIC LUMINESCENCE. A.Zmerli and P.Pesteil.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1757-9 (Nov. 26, 1956). In French.

535.371 : 539.234

4174. FORMATION OF LUMINESCENT FILMS BY EVAPORATION. C.Feldman and M.O'Hara.
J. Opt. Soc. Amer., Vol. 47, No. 4, 300-5 (April, 1957).

Luminescent films of ZnS [Mn], Zn_2SiO_4 [Mn], $Zn_3(PO_4)_3$[Mn], CaF_2[Mn], and $CaWO_4$[W] have been formed by evaporation in a vacuum and a subsequent heat treatment. Most of the films may be made either transparent or fogged depending on the post-heat treatment. The luminescent brightness of the fogged films, under cathode cathode-ray excitation, approaches the brightness of the bulk powdered material. The brightness of the transparent films is limited chiefly by internal reflection. In general, the phosphor chemistry of the powdered materials has been found to be applicable to thin films. A.

535.371

4175. LUMINESCENCE IN ELECTRONICALLY ACTIVE SOLIDS. H.W.Leverenz.
J. Phys. Radium, Vol. 17, No. 8-9, 612-15 (Aug.-Sept., 1956). In French.

There are three basic electronic activities in phosphors and other electronically active solids. These activities are (1) orientation of spin, (2) excitation leading to radiation, (3) unilateral displacement. Atomic interaction provides, through chemical synthesis, effective means for modifying, controlling and combining these activities. Research in this field has made many physical phenomena tractable and useful, and has afforded greater understanding of the fundamental natures of solids and of luminescence. A.

535.371

4176. PHOTOLUMINESCENCE OF CALCIUM META-ANTIMONATE ACTIVATED BY BISMUTH. R.Bernard and J.Janin.
J. Phys. Radium, Vol. 17, No. 8-9, 616-19 (Aug.-Sept., 1956). In French.

The emission and excitation spectra of $CaSb_2O_6$(Bi) are described for different activator concentrations and temperatures. The observed results are explained by assuming the existence of two kinds of centres. A.

535.371

4177. CHEMICAL STRUCTURE OF LUMINESCENCE CENTRES IN ZnS AND ZnO. N.Riehl and H.Ortmann.
J. Phys. Radium, Vol. 17, No. 8-9, 620-3 (Aug.-Sept., 1956). In French.

Activated zinc sulphides may be obtained by desulphurization (e.g. with H_2); it is not necessary to introduce Cl_2 or trivalent "coactivators". Evidence is given for the vicinity of Cu S-vacancies in ZnS(Cu). Prolonged heating of ZnS in HCl without H_2O also produces free Zn ions. Blue luminescent unactivated ZnS cannot be obtained in the absence of O_2. A.

535.371

4178. COMPARATIVE STUDY OF Ag AND Cu LUMINESCENCE CENTRES IN CdS AND ZnS PHOSPHORS. E.Grillot.
J. Phys. Radium, Vol. 17, No. 8-9, 624-9 (Aug.-Sept., 1956). In French.

Two kinds of luminescent centres are observed in CdS(Ag) as in CdS(Cu) (red or infrared emissions). The distances between their energy levels and the full band indicate an analogy of structure with the corresponding ones in ZnS. The substitutional position of the foreign atom and its monovalence in both cases of ZnS(Cu) are in agreement with the representation previously proposed by the author. A.

535.371

4179. THE INFLUENCE OF FLUXES ON THE COLOUR OF LUMINESCENT SULPHIDES OF ZINC AND CADMIUM. S.Rothschild and G.K.Eaton.
J. Phys. Radium, Vol. 17, No. 8-9, 630-2 (Aug.-Sept., 1956). In French.

The spectral distribution of the reflectivity of luminescent sulphides depends on the composition of fluxes (dimension of particles, and perhaps presence of solid solutions of barium sulphide, strontium sulphide or other sulphides in the lattice). A.

535.371

4180. ON THE LUMINESCENCE OF THE NATURAL CALCINED PHOSPHATES OF NORTH AFRICA. A.Guntz.
J. Phys. Radium, Vol. 17, No. 8-9, 633 (Aug.-Sept., 1956). In French.

535.371

4181. RELATION BETWEEN THE CONCENTRATIONS OF CHLORINE AND OF COPPER IN ZnS:Cu,Cl. T.B.Tomlinson.
J. Phys. Radium, Vol. 17, No. 8-9, 634 (Aug.-Sept., 1956). In French.

535.371

4182. ON THE METHODS OF PREPARATION OF PHOSPHORESCENT CRYSTALS. F.D.Klement.
J. Phys. Radium, Vol. 17, No. 8-9, 635 (Aug.-Sept., 1956). In French.

535.371

4183. CONTRIBUTION TO THE CHEMISTRY OF CALCIUM HALOPHOSPHATES. W.L.Wanmaker.
J. Phys. Radium, Vol. 17, No. 8-9, 636-40 (Aug.-Sept., 1956). In French.

Detailed study of the secondary reactions during the preparation of calcium halophosphates activated by Sb^{3+} or Mn^{2+}, in order to suppress the formation of Sb^{5+} or Mn^{3+} ions, or of free Sb_2O_3 and Mn_3O_4, the effect of which is to lower the quantum efficiency. A.

535.371

4184. SOME CONSIDERATIONS OF THE ENERGY TRANSFER IN HALOPHOSPHATES. J.L.Ouweltjes.
J. Phys. Radium, Vol. 17, No. 8-9, 641-4 (Aug.-Sept., 1956). In French.

Measurements have been made of the quantum efficiency of halophosphates activated by Sb and Mn, and of the killer effect of iron. The energy transfers between activator, sensitizer and killer ions are discussed. Possibly the greatest part of the killer effect of iron is a mere absorption. A.

535.371

4185. LUMINESCENCE CENTRES IN FLUORIDES ACTIVATED BY URANIUM. W.A.Runciman.
J. Phys. Radium, Vol. 17, No. 8-9, 645-8 (Aug.-Sept., 1956). In French.

The idea of localized charge compensation is introduced, and used to obtain probable atomic configurations in uranium-activated fluorides, particular attention being given to uranium-activated sodium fluoride. High-dispersion fluorescence and absorption spectra of various sodium fluoride phosphors are shown and discussed. There are large effects due to other impurities present and also to cooling down from 77°K to 4.2°K. A.

535.371

4186. FLUORESCENCE SPECTRA OF NATURAL IRRADIATED DIAMONDS. I.G.Matthews.
J. Phys. Radium, Vol. 17, No. 8-9, 649 (Aug.-Sept., 1956). In French.

535.371 : 537.312.5

4187. THE ACTION OF VAPOURS AND OF OXYGEN ON THE PHOTOELECTRIC EFFECT AND LUMINESCENCE OF ZnO. A.Terenine, E.Putzeiko and K.Tagantzev.
J. Phys. Radium, Vol. 17, No. 8-9, 650-5 (Aug.-Sept., 1956) In French.

The photoluminescence of a microcrystalline layer of ZnO behaves in the presence of O_2 and H_2O adsorbed together in an opposite manner to that of the photoelectric effect. Quinone vapour may replace O_2. The observed phenomena are explained by a decrease of the recombination rate due to an electronic affinity of the adsorbed molecules. A.

535.371

4188. OPTICAL ANISOTROPY OF LUMINESCENCE CENTRES IN CUBIC CRYSTALS. P.P.Feofilov.
J. Phys. Radium, Vol. 17, No. 8-9, 656-62 (Aug.-Sept., 1956). In French.

Some cubic crystals have a polarized emission. This fact is interpreted by representing luminescent centres as oscillators directed along the crystalline axes. Conclusions are derived on the nature of these centres. A.

535.371

4189. MODELS OF LUMINESCENCE CENTRES IN SULPHIDES. J.Lambe and C.C.Klick.
J. Phys. Radium, Vol. 17, No. 8-9, 663-6 (Aug.-Sept., 1956). In French.

The authors discuss both the conventional model, in which the luminescence emission is ascribed to the capture of a conduction electron by the centre, and their own model, in which the luminescence emission is ascribed to the capture of a free hole. New experiments have been performed in order to check the predictions of these models. A.

535.371

4190. THEORY OF LUMINESCENCE CENTRES OF THE ASSOCIATED DONOR-ACCEPTOR TYPE. J.S.Prener and F.E.Williams.
J. Phys. Radium, Vol. 17, No. 8-9, 667-72 (Aug.-Sept., 1956). In French.

Activator and coactivator impurities in ZnS act like acceptors and donors. Coulomb interaction between them produces a great degree of association. The edge emission is ascribed to nearest-neighbour acceptor-donor pairs; the pairs which are not of the nearest-neighbour type are identified with the luminescence centres. A.

535.371

4191. PARAMAGNETIC RESONANCE IN PHOSPHORS. W.D.Hershberger.
J. Phys. Radium, Vol. 17, No. 8-9, 672 (Aug.-Sept., 1956). In French.

535.371

4192. INFRARED EMISSION AND COMMON LEVEL SCHEME OF ZnS, CdS, ZnCdS, ETC., PHOSPHORS. G.F.J.Garlick.
J. Phys. Radium, Vol. 17, No. 8-9, 673 (Aug.-Sept., 1956). In French.

535.371

4193. EXISTENCE OF AN INTENSIFIER EFFECT OF THE IRON GROUP ELEMENTS AND SITUATION OF A FERMI LEVEL IN LUMINESCENT SULPHIDES. N.Arpiarian.
J. Phys. Radium, Vol. 17, No. 8-9, 674-8 (Aug.-Sept., 1956). In French.

Besides the well known killer effect of Fe, Ni and Co, an intensifier effect is observed at low concentrations, specially of Fe and Co on gold activated sulphides. The situation of the electronic levels and the dependence of the Fermi level on concentration and temperature are discussed. A.

535.371 : 535.345

4194. THE EFFECT OF QUENCHERS ON THE ABSORPTION AND EMISSION SPECTRA OF SILVER-ACTIVATED ZINC SULPHIDES. G.Gergely.
J. Phys. Radium, Vol. 17, No. 8-9, 679-83 (Aug.-Sept., 1956). In French.

The efficiency of the visible blue emission is decreased. A red emission for iron, a near-infrared emission for nickel and a farther emission for cobalt are observed. For high concentrations these emissions are also quenched. The effect on absorption and reflection spectra is discussed. A new method for the determination of the absorption coefficient of microcrystals is described in an appendix. A.

535.371

4195. INFLUENCE OF THE EXISTENCE OF SEVERAL TRAP SYSTEMS AND OF THE RECAPTURE PHENOMENON ON THE LAW OF DECAY OF PHOSPHORESCENCE. V.Levchine.
J. Phys. Radium, Vol. 17, No. 8-9, 684-7 (Aug.-Sept., 1956). In French.

The empirical hyperbolic decay law results from (a) the dispersion of trap depths inside the different systems of traps; (b) the electron retrapping. The author discusses the importance of these phonomena and the dependence of the decay law on temperature with respect to the glow temperatures of the phosphor. A.

535.371

4196. ON NON-ISOTHERMAL RELAXATION PROCESSES IN PHOSPHORESCENT CRYSTALS. T.B.Louchtchik.
J. Phys. Radium, Vol. 17, No. 8-9, 687-8 (Aug.-Sept., 1956). In French.

535.371

4197. MODEL OF THE BANDS IN PHOSPHORESCENT CRYSTALLINE SULPHIDES. M.Schön.
J. Phys. Radium, Vol. 17, No. 8-9, 689-93 (Aug.-Sept., 1956). In French.

The assumptions made in the band scheme are examined. They concern the behaviour of electrons and holes, free or bound to the crystal defects. It is shown that these assumptions are generally valid. The processes of action and the representation of the defects in the energetic levels scheme are discussed. A.

535.371

4198. ON THE EFFICIENCY OF THE LUMINESCENCE IN CRYSTALLINE PHOSPHORS. V.V.Antonov-Romanovsky.
J. Phys. Radium, Vol. 17, No. 8-9, 694-8 (Aug.-Sept., 1956). In French.

The quantum efficiency of the luminescence of ZnS(Cu) and ZnS(Cu,Co) has been investigated from both experimental and theoretical points of view. The effect of the excitation intensity and the killer effect of cobalt are discussed. The efficiency depends on the excitation wavelength according to Vavilov's law. A.

535.371

4199. THEORETICAL AND EXPERIMENTAL STUDY OF SOME PROPERTIES OF ELECTRON TRAPS AND LUMINESCENCE CENTRES IN SULPHIDES. D.Curie.
J. Phys. Radium, Vol. 17, No. 8-9, 699-704 (Aug.-Sept., 1956). In French.

The radiative recombination mechanism in phosphorescence depends on the kinetic energy of the conduction electrons and also on the spatial distribution of centres and traps. Several experiments show, in some cases, localization of the traps in the neighbourhood of the activator centres. Some objections against this viewpoint are given. A.

535.371

4200. THE BECQUEREL FORMULA AND THE ELEMENTARY DECAY LAW OF LUMINESCENCE. E.I.Adirovitch.
J. Phys. Radium, Vol. 17, No. 8-9, 705-7 (Aug.-Sept., 1956). In French.

535.371 : 537.312.5

4201. ACTION OF ADDITIONAL ILLUMINATION OR OF A CONSTANT FIELD ON THE SPECTRUM OF PHOTOELECTRIC SENSITIVITY. A.Terenine.
J. Phys. Radium, Vol. 17, No. 8-9, 708 (Aug.-Sept., 1956). In French.

535.371

4202. ON THE EFFECT OF CONTINUOUS ELECTRIC FIELDS ON THE BRIGHTNESS OF LUMINESCENT SUBSTANCES KEPT UNDER EXCITATION. E.Alexander, W.Low, I.T.Steinberger and S.Z.Weisz.
J. Phys. Radium, Vol. 17, No. 8-9, 737-41 (Aug.-Sept., 1956). In French.

Application of d.c. fields to u.v. excited ZnS.CdS phosphors results in a rapid light pulse and a subsequent quenching. A second pulse and quenching are observed on short-circuiting the phosphor cell. The dependence of the amplitudes of these pulses on the applied voltage, on the polarity of the illuminated electrode and on the past history of the cell is investigated. Explanations of these effects are given. A.

535.371

4203. ON THE LUMINESCENCE OF OXIDE LAYERS FORMED BY ELECTROLYTIC OXIDATION. W.C.van Geel.
J. Phys. Radium, Vol. 17, No. 8-9, 714-17 (Aug.-Sept., 1956). In French.

Measurements of the luminescence L produced during the formation of layers obtained by anodic oxidation give $L = aI(e^{bd} - 1)$; I intensity of current, d thickness of the layer. When a.c. is applied, light is observed at each change of polarity. A.

535.371

4204. SPECTRAL DISTRIBUTION OF THE ELECTRO-ENHANCEMENT EFFECT OF CdS—ZnS MIXTURES ACTIVATED BY MANGANESE AND SILVER. G.Destriau.
J. Phys. Radium, Vol. 17, No. 8-9, 734-6 (Aug.-Sept., 1956). In French.

The magnitude of the "electro-enhancement effect" (the increase in the X-ray excited fluorescence of certain phosphors when an electric field is applied) is quite different according to the spectral region observed. The maximum enhancement for the samples used (70%, ZnS, 30% CdS) is obtained at about 6000 A; here the brightness is increased by a factor which may be as high as four when the field is applied. For shorter wavelengths (below about 5000 A), however, the enhancement effect disappears and, in some cases, is even replaced by a quenching effect. A.

535.371

4205. ON THE ENHANCEMENT AND QUENCHING OF THE LUMINESCENCE OF MANGANESE-ACTIVATED ZINC SULPHIDES BY ALTERNATING ELECTRIC FIELDS. H.Gobrecht and H.E.Gumlich.
J. Phys. Radium, Vol. 17, No. 8-9, 754-7 (Aug.-Sept., 1956). In French.

According to the method of excitation, intensity of excitation, frequency of the applied field, and observed emission band, the alternating field can produce a quenching or an enhancing of luminescence in ZnS(Mn). These two processes seem to be independent. A.

535.371

4206. ENHANCEMENT OF THE LUMINESCENCE OF α SCINTILLATIONS BY ELECTRIC FIELDS. J.Mattler.
J. Phys. Radium, Vol. 17, No. 8-9, 758 (Aug.-Sept., 1956). In French.

535.371

4207. "SPECIAL" ELECTRONIC EMISSION, LUMINESCENCE AND COLOUR CENTRES IN PHOSPHORESCENT INORGANIC CRYSTALS. A.Bohun.
J. Phys. Radium, Vol. 17, No. 8-9, 783-6 (Aug.-Sept., 1956). In French.

Several crystals with colour centres show an effect, called by the author "special electronic emission", which is observed after the excitation has ceased. Comparative study of thermoemission, thermoluminescence and absorption leads to results on the structure of the crystals. The samples used may be monocrystalline or powdered. A.

535.371

4208. OPTICAL EXCITATION OF ZINC AND CADMIUM SULPHIDES. H.P.Kallmann.
J. Phys. Radium, Vol. 17, No. 8-9, 787-9 (Aug.-Sept., 1956). In French.

The conditions for stimulability of phosphors are investigated. The requirement of sufficient energy storage is fulfilled for practically all phosphors. The following model for stimulable phosphors is proposed: they must have special emission centres which enable the electrons to recombine rapidly with positive holes in radiative transitions. Infrared irradiation releases holes from activators; these holes are transferred to the recombination centres. The model explains many features of excitation and quenching of light and conductivity. A.

535.371

4209. ON THE ENERGY LEVEL SCHEME OF PHOSPHORESCENT CRYSTALS. I.Broser and R.Broser-Warminsky.
J. Phys. Radium, Vol. 17, No. 8-9, 791-6 (Aug.-Sept., 1956). In French.

The emission, absorption, stimulation and quenching spectra of ZnS and CdS single crystals are investigated. The importance of making all these experiments on the same sample is pointed out. The energy-levels scheme is derived for self-activated or Cu-activated ZnS and CdS. A.

535.371 : 537.312.5

4210. LUMINESCENCE AND CONDUCTIVITY OF ZnS(Cu) SINGLE CRYSTALS. D.R.Hamilton.
J. Phys. Radium, Vol. 17, No. 8-9, 797-800 (Aug.-Sept., 1956). In French.

The luminescence and conductivity of a set of single crystals of ZnS activated by varying amounts of copper have been investigated. Considerable difficulties exist with the present models for temperature quenching. Conductivity measurements, although complicated by non-ohmic contacts, suggest the luminescence centres are the donors of photoelectrons. Lattice irregularities or Cu_2S centres are believed to be predominant donors of semi-conduction electrons. A.

535.371 : 537.312.5

4211. SOME METHODS AND RESULTS OF THE KINETIC STUDY OF LUMINESCENCE AND PHOTOCONDUCTIVITY. N.Tolstoi.
J. Phys. Radium, Vol. 17, No. 8-9, 801-5 (Aug.-Sept., 1956). In French.

Different methods have been developed to study the relaxation processes (build-up and decay) of luminescence and photoconductivity in the range 10^{-1}-2.10^{-8} sec. Many results led to a "pseudo-monomolecular two-stage mechanism". Evidence for conductivity through a quasi-band of localized electronic levels is given. A.

535.371

4212. THE PHOTODIELECTRIC EFFECT OBTAINED WITH ZnS(Cu, Co) AND ZnS(Cu, Ni). J.Roux.
J. Phys. Radium, Vol. 17, No. 8-9, 813-14 (Aug.-Sept., 1956). In French.

In a previous study, it was pointed out that the dispersion of the complex dielectric constant of excited phosphor powders could result from three processes: the first kind due to the dispersion of crystal dielectric constant, the second and the third kind being two kinds of peculiar Maxwell—Wagner dispersions. The experiments described here are concerned with ZnS(Cu), ZnS(Cu, Ni), and ZnS(Cu, Co). At a given frequency, the measurements of the real and imaginary part of the complex dielectric constant of the powder, show a killing effect on the dielectric change, parallel to the quenching of phosphorescence. For an equal quantity of killer, the killing effect is much more important with Ni. Further experiments with ZnS(Cu, Co) show that the main phenomenon impelled by introduction of Co, is a decrease of the critical frequency in the first kind effect dispersion region, while the static dielectric constant related to this region is hardly disturbed. In terms of a theory published elsewhere, this implies an increase of the barrier height inside the two-well-traps concerned. On the other hand, photoconductivity is increased, so that in the second kind of effect the dispersion region overlaps the first one. A.

535.371

4213. FLUORESCENCE OF THE EXCITON IN PURE CdS. E.Grillot.
J. Phys. Radium, Vol. 17, No. 8-9, 822-3 (Aug.-Sept., 1956). In French.

535.371

4214. THE MECHANISM OF CONCENTRATION EXTINCTION OF THE FLUORESCENCE OF ANTHRACENE SOLUTIONS. B.Ya.Sveshnikov and G.A.Tishchenko.
Optika i Spektrosk, Vol. 1, No. 2, 155-60 (1956). In Russian.

The output and duration of the fluorescence of anthracene in various solvents, e.g. benzene, ether, acetone, paraffin oil, are considered and a study made of their variation with anthracene concentration. The ratio $(\tau_0-\tau)/\tau$, where τ_0 and τ are the magnitudes of the durations of fluorescence in unextinguished and extinguished solutions respectively, is shown to increase proportionally with concentration of anthracene and fluidity of the solvent. Output changes on the other hand considerably exceed changes of durations, hence, besides extinction due to Brownian motion of molecules

there exists also a static extinction. It is shown that the latter arises on account of fluctuations in distribution of anthracene molecules in solution and cannot be explained by association of non-excited anthracene molecules or by any photo-chemical reaction.
C.R.S.Manders
535.371

4215. TRANSFER OF EXCITATION ENERGY IN ANTHRACENE CRYSTALS WITH ADMIXTURE OF NAPHTHACENE. M.D.Galanin and Z.A.Chizhikova.
Optika i Spektrosk., Vol. 1, No. 2, 175-80 (1956). In Russian.
Briefly describes the making of the crystals, the measurement of the relative output and the luminescence spectra, the measurement of the absorption spectra, and the determination of the duration of fluorescence. Curves are given showing output v. duration of fluorescence (mean period of excited state). Calculation of the resonant transfer of energy from anthracene to naphthacene gives values lower than those actually found. It is suggested that there must be migration of energy through the anthracene lattice due to "localized excitons". C.R.S.Manders
535.371

4216. LUMINESCENCE OF POTASSIUM IODIDE. K.J.Teegarden.
Phys. Rev., Vol. 105, No. 4, 1222-7 (Feb. 15, 1957).
When single crystals of potassium iodide are cooled to -160^0 C and illuminated with light absorbed in the first fundamental band they luminesce with a quantum yield between 0.5 and 1. The excitation and emission spectra of this luminescence are presented. The experiments suggested that pure KI itself luminesces under the above conditions and that the luminescence can be modified by the presence of impurities or defects in the lattice. A.
535.371

4217. PHOTOFLUORESCENCE DECAY TIMES OF ORGANIC PHOSPHORS. T.D.S.Hamilton.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 144-5 (Jan., 1957).
535.372 : 535.343

4218. INVESTIGATION OF ANTI-STOKES FLUORESCENCE OF THE VAPOURS OF AROMATIC COMPOUNDS. B.S.Neporent and N.A.Borisevich.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 447-50 (1954). In Russian.
Investigation of the spectrum and of the quantum efficiency of fluorescence of a rarified vapour provides information on the process of conversion of energy by molecular absorption and an experimental examination of Vavilov's (J. Phys. USSR, Vol. 9, 68, 1945) law. It has been shown (Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 15, 533, 1951) that many of the fluorescent properties of aromatic bonds are conditioned by intermolecular reactions and not by intramolecular interaction. The present results extend this concept. The absorption spectra and the fluorescent spectra are plotted for 3-aminophthalimide, 3,6-diaminophthalimide and 3,6-tetramethyldiaminophthalimide. W.Bardsley
535.372

4219. ON THE NARROW BANDS IN THE LUMINESCENCE SPECTRUM OF SOME CRYSTALS AT LOW TEMPERATURES. V.A.Arkhanguelskaia and P.P.Feofilov.
J. Phys. Radium, Vol. 17, No. 8-9, 824-5 (Aug.-Sept., 1956). In French.
535.372

4220. SPECTRAL RELATIONSHIPS OF LUMINESCENT OUTPUTS. V.V.Zelinskiĭ, V.P.Kolobkov and L.G.Pikulik.
Optika i Spektrosk., Vol. 1, No. 2, 161-7 (1956). In Russian.
The authors have discovered a connection between the values of fluorescent output and the spectral position of fluorescent bands. This indicates that a decisive part is played, in the extinction of fluorescence, by the mutual distribution of excitation and ground energy levels. The existence is noted of two different processes for non-radiating de-activation: (a) a process of extra-molecular temperature extinction, the probability of which increases with spectrum shift towards greater wavelengths, and (b) a process which the authors suggest is caused by a transition of excited molecules into a metastable state. Impurity extinction of fluorescence is also discussed. C.R.S.Manders
535.373 : 537.312.5

4221. FORMAL ANALYSIS OF THE THEORY OF TWO-STAGE EXCITATION OF PHOSPHORESCENCE AND PHOTOCONDUCTIVITY. I. STEADY-STATE RELATIONSHIPS. N.A.Tolstoĭ and A.V.Shatilov.
Optika i Spektrosk., Vol. 1, No. 2, 216-29 (1956). In Russian.
Theoretical paper to be followed by a sequel dealing with the formal analysis of relaxation relationships given by two-stage theory. The current paper assumes that recombination is caused by a reaction of first order (pseudomonomolecular recombination). It is shown that many properties considered typical of models with bimolecular recombination under normal one-stage excitation can be obtained from a model with pseudomonomolecular recombination and two-stage excitation. C.R.S.Manders
535.373 : 539.11

4222. THE DECAY LAW FOR BAND MODELS OF CRYSTAL PHOSPHORS. G.M.Éliashberg.
Optika i Spektrosk., Vol. 1, No. 2, 230-9 (1956). In Russian.
For interpreting many of the properties of phosphorescence decay, and in particular the shape of decay curves, the simpler band model is inadequate. A calculation is made for a model with two types of capture level, from which it follows that certain peculiarities of the kinetics of the capture process may be associated with electron redistribution between capture levels of various types. C.R.S.Manders
535.375.5

4223. RAMAN SPECTRUM AND STRUCTURE OF THE PHASE IV OF AMMONIUM NITRATE. D.Penot, H.Poulet and J.P.Mathieu.
C.R. Acad. Sci. (Paris), Vol. 243, No. 18, 1803-5 (Oct. 29, 1956). In French.
The frequencies, intensities and assignments of Raman lines observed in the range 85-3250 cm^{-1} are tabulated. The results are briefly discussed. G.I.W.Llewelyn
535.375.5 : 535.343

4224. RAMAN AND INFRARED SPECTRA OF 2-THIABUTANE. M.Hayashi, T.Shimanouchi and S.Mizushima.
J. chem. Phys., Vol. 26, No. 3, 608-12 (March, 1957).
Raman spectra of 2-thiabutane have been measured in the liquid and crystalline states. Infrared spectra of these substances have been recorded in the vapour, liquid, and crystalline states. The skeletal frequencies for different rotational isomers have been calculated by the use of a potential function of the Urey–Bradley type. It was concluded that in the gaseous and liquid states there exist both the trans and gauche isomers, of which only the former persists in the crystalline state. These two rotational isomers have been found to have nearly the same energy in the gaseous and liquid states. A.
535.376 : 548.7

4225. ON THE INTERMOLECULAR TRANSFER OF EXCITATION ENERGY IN CRYSTALS. E.K.Zavoĭskiĭ and G.E.Smolkin.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 2, 328-30 (1956). In Russian.
Alpha-particles from Po^{210} are allowed to strike a single crystal of either CsI(Tl) or anthracene and the luminescent light emitted falls on the photocathode of an electron/optical transducer with a gain of 300 and the emitted light is photographed. Each luminescence photon gives a distinct spot in the photograph of the tracks. The average number is 10 per track in anthracene and 150 in CsI with tracks about 25 μ long. The photons are seen to be emitted less than 1 μ from the centre of the width of the track. This places an upper limit of 1 μ to the free path of the energy transfer inside the crystals. D.H.Whiffen
535.376

4227. EFFECT OF TEMPERATURE ON THE ELECTROLUMINESCENCE OF ZnS SINGLE CRYSTALS OF DIFFERENT COMPOSITION. C.F.Alfrey.
J. Phys. Radium, Vol. 17, No. 8-9, 719-24 (Aug.-Sept., 1956). In French.
The electroluminescence of ZnS single crystals containing different amounts of copper is described. The electroluminescence is a maximum at a certain temperature characteristic of the crystal, this temperature being lower, the higher the copper concentration. These results are in accordance with a mechanism previously developed, if the effect of quenching of the light emission at high temperatures is considered. A.
535.376

4226. ELECTROLUMINESCENCE IN WEAK FIELDS. R.W.Smith.
J. Phys. Radium, Vol. 17, No. 8-9, 713 (Aug.-Sept., 1956). In French.
535.376

4228. THE EVOLUTION OF BRIGHTNESS WAVES IN ELECTROLUMINESCENCE AND THE EFFECT OF FIELD AND TEMPERATURE. J.Mattler.
J. Phys. Radium, Vol. 17, No. 8-9, 725-30 (Aug.-Sept., 1956). In French.
The brightness-wave dependence on voltage and temperature has been investigated. With ZnS(Mn) the waveform remains simple; this supports the hypothesis of transitions inside the centres. With ZnS activated by Cu, Ag or Pb the temperature acts chiefly on the position and intensity of the secondary peaks; the waveform becomes simpler at high temperatures. A.

535.376

4229. BRIGHTNESS WAVES IN THE ELECTROLUMINESCENCE OF ZnS SINGLE CRYSTALS. D.R.Frankl, J.L.Birman, G.F.Neumark and A.Lempicki.
J. Phys. Radium, Vol. 17, No. 8-9, 731 (Aug.-Sept., 1956). In French.

535.376

4230. ON THE HOMOGENEITY OF THE ELECTROLUMINESCENT EMISSION OF ZnS SINGLE CRYSTALS. A.Lempicki, D.R.Frankl, G.F.Neumark and J.L.Birman.
J. Phys. Radium, Vol. 17, No. 8-9, 732 (Aug.-Sept., 1956). In French.

535.376

4231. INFLUENCE OF TEMPERATURE ON THE ELECTROLUMINESCENCE OF ZnS SINGLE CRYSTALS. G.F.Neumark, D.R.Frankl, A.Lempicki and J.L.Birman.
J. Phys. Radium, Vol. 17, No. 8-9, 733 (Aug.-Sept., 1956). In French.

535.376

4232. PHOTOELECTROLUMINESCENCE — RADIATION CONTROLLED ELECTROLUMINESCENCE. D.A.Cusano and F.E.Williams.
J. Phys. Radium, Vol. 17, No. 8-9, 742-7 (Aug.-Sept., 1956). In French.

The control of electroluminescence by an u.v. or X-irradiation is called photoelectroluminescence. This phenomenon has been observed with ZnS(Mn,Cl) films; each u.v. photon produces many emitted quanta. The Mn centres are excited by impact of accelerated electrons, but also by resonance transfers with the hole-electron pairs produced by the accelerated electrons. The shift of the emission spectrum is ascribed to a Stark effect of the Mn ions. A.

535.376

4233. ON THE ELECTROTHERMOLUMINESCENCE EFFECT. D.Hahn.
J. Phys. Radium, Vol. 17, No. 8-9, 748-53 (Aug.-Sept., 1956). In French.

The electroluminescence of some phosphors is different during cooling and heating; some maxima appear, not unlike to those of the "glow curves". This phenomenon, called "electrothermoluminescence", is ascribed to electron multiplication produced by conduction electrons issued from the traps. The position of the maxima corresponds to that of the glow maxima; they are independent of field strength, frequency and heating rate. A similar effect is observed under cathodo-excitation (cathodothermoluminescence). A.

535.376

4234. RELATION BETWEEN THE BRIGHTNESS OF ELECTROLUMINESCENT CELLS AND THE APPLIED POWER. D.W.G.Ballentyne.
J. Phys. Radium, Vol. 17, No. 8-9, 759-62 (Aug.-Sept., 1956). In French.

The voltage dependence of brightness and efficiency can be explained in terms of the power dissipated in a resistor. An attempt is made to suggest the physical reality (a kind of p-n junction) connected with the circuit. A.

535.376

4235. ON THE MECHANISM OF ELECTROLUMINESCENCE. R.Goffaux.
J. Phys. Radium, Vol. 17, No. 8-9, 763-8 (Aug.-Sept., 1956). In French.

Interpretation by the Fröhlich model (the electronic temperature depending on the field) of the saturation in brightness with frequency, the initial build-up in intensity during the first few cycles, and the asymmetry of the brightness waveform. Relation between the brightness and the applied voltage. A.

535.376

4236. ELECTROLUMINESCENT CONDENSERS IN OSCILLATING CIRCUITS. A.Luyckx, M.Weiler and A.J.Stokkink.
J. Phys. Radium, Vol. 17, No. 8-9, 769-72 (Aug.-Sept., 1956). In French.

For a series circuit of an inductor and an electroluminescent condenser, most of the phenomena predicted by the classical theory can be observed. However, the form of the luminance resonance curves depends on the power factor of the e.l. condenser. Calculations on equivalent circuits give good agreement with experimental resonance curves. A.

535.376

4237. ELECTROLUMINESCENCE PHENOMENA. E.Nagy.
J. Phys. Radium, Vol. 17, No. 8-9, 773-6 (Aug.-Sept., 1956). In French.

The impact excitation mechanism of electroluminescence is used in connection with Shockley's idea of an electronic temperature depending on the field. The different relaxation processes involved are discussed. An expression for the field—brightness relation is derived and checked with experiment. A.

535.376

4238. ON THE ELECTROLUMINESCENCE OF ZINC SULPHIDE (DESTRIAU EFFECT). P.Zalm.
J. Phys. Radium, Vol. 17, No. 8-9, 777-82 (Aug.-Sept., 1956). In French.

Theoretical and experimental study of a rectifier barrier between ZnS and Cu_2S. The luminance—voltage relation in $\exp(-b/V^{1/2})$ derived is in good agreement with experiments. Heating modifies the value of b. A.

535.376

4239. EXCITATION OF LUMINESCENCE IN GASES BY 2-4 keV LITHIUM IONS. R.W.Nicholls and D.Pleiter.
Nature (London), Vol. 178, 1456-7 (Dec. 29, 1956).

A thermionic source produced a beam of Li^+ ions used to bombard N_2, O_2, A and air at 5 to 40 μ mercury pressure. The main lines identified in the spectra were those of Li I, of neutral and ionized N and A, and or neutral O (according to the gas used). Less prominent were N_2^+ bands. Others working with higher energy ions have reported strong N_2^+ bands and also N_2 bands (see Abstr. 2264/1954). The excitation mechanism is discussed, and the differences from other work attributed to the comparatively long collision time in the present case. This allows dissociation to occur, whereas with short collision times only charge transfer is possible. S.T.Henderson

535.377 : 539.11

4240. ORIGIN OF LOCALIZATION LEVELS IN ZnS—Cu,Co PHOSPHORS. V.L.Levshin, V.F.Tunitskaya and A.A.Cherepnev.
Optika i Spektrosk., Vol. 1, No. 2, 255-63 (1956). In Russian.

Experimental conditions have been carefully investigated so as to ensure reproducible thermoluminescence curves. Materials studied were ZnS, ZnS—Cu, ZnS—Co and ZnS—Cu,Co, which were prepared by calcination in atmospheres of H_2S, N_2 or air. From the thermoluminescence curves obtained under varied conditions the authors derive conclusions about the origin of the separate groups of levels. C.R.S.Manders

535.377 : 539.11

4241. DETERMINATION OF THE EFFECTIVE CROSS-SECTIONS OF CAPTURE AND RECOMBINATION OF THERMAL ELECTRONS IN THE PHOSPHOR ZnS—Cu,Co. Syuĭ-Syuĭ-Yun.
Optika i Spectrosk., Vol. 1, No. 2, 264-70 (1956). In Russian.

Thermal luminescence curves are analysed and the cross-sections estimated from this. The results obtained are in concordance with the diffusion theory of phosphorescence. C.R.S.Manders

535.39

4242. STUDIES OF THIN FILMS IN REFLECTED LIGHT. R.Reiss.
J. Phys. Radium, Vol. 17, No. 8-9, 820 (Aug.-Sept., 1956). In French.

535.391

4243. ON THE REFLECTION AND TRANSMISSION OF LIGHT THROUGH THIN TRANSPARENT FILMS. A.Vašíček.
Czech. J. Phys., Vol. 6, No. 4, 341-8 (Aug., 1956).

A formula is deduced for the reflection and transmission of light through one thin film. The direction of the passing rays of light (right and left) is taken into account whereby a formula is obtained which is more general than that usually used. The former was used as the starting point for the deduction of formulae for the reflection and transmission of light through two and more thin films which were published by the author some years ago. An explanation is given of the complication of the formulae when the reflection of light from the upper film, adjacent to the air, is computed. The auxiliary phase deduced by the author in a previous paper is also explained as a necessary consequence. A.

535.394

4244. THE THEORY OF TOTAL REFLECTION. J.Picht.
Abhandl. Dtsch. Akad. Wiss. Berlin Kl. Math. Phys. Tech., No. 2, 54 pp. (1955). In German.

A complete account is given of the theory of total reflection at

a surface, using diffraction integrals. The results are interpreted into geometric-optical terms to illustrate some experimentally determined phenomena. R.W.Fish

535.417

4245. UNCOMPENSATED CORNER-REFLECTOR INTERFEROMETER. E.R.Peck.
J. Opt. Soc. Amer., Vol. 47, No. 3, 250-2 (March, 1957).

Analysis is made of the effect of omitting the compensating plate in a corner-reflector interferometer. It is concluded that a non-compensated instrument has disadvantages when compared to a compensated one, but when properly adjusted it may still be useable with a photoelectric detector. The flux is integrated over rectangular field stops. A.

535.434

4246. EXTINCTION OF LIGHT BY SUSPENSIONS OF SILICA DUST. J.McK.Ellison.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 102-10 (Jan., 1957).

Application of approximations relating to spheres to the scattering of light by polydisperse dust clouds is discussed theoretically. If the relative refractive index of the particles is low, the shapes of the particles are not extreme, the particles are not orientated, and only the scattering forward through angles less than 30^0 is considered, the scattering seems likely to resemble that by clouds of spheres of the same sizes. Forward scattering and extinction by carefully fractionated silica dusts suspended in liquid were measured using an extinction method, and for particles larger than 2 microns showed good agreement with Mecke's approximation. For smaller particles absolute extinction measurements were not made, but relative values indicated the presence of aggregates. The aggregates seemed to diffract like opaque discs, and the unaggregated particles seemed to scatter like Rayleigh—Gans spheres. A.

535.434

4247. THE THEORY OF LIGHT SCATTERING BY SUSPENSIONS OF RANDOMLY ORIENTED LONG PRISMS. A.R.Stokes.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 379-89 (April, 1957).

A general asymptotic formula is developed for the normalized intensity of scattering by long thin prisms of specified length and cross-section. This is applied to the particular case of long, thin, parallel-sided strips, both monodisperse and polydisperse. The effect of interaction between strips in contact is also considered. A.

535.435

4248. VALIDITY OF THE LANDAU PLACZEK RELATIONSHIP IN BRILLOUIN SCATTERING IN LIQUIDS. D.H.Rank.
J. Opt. Soc. Amer., Vol. 47, No. 1, 103-4 (Jan., 1957).

The relationship is tested on the measurements of Rank et al. (Abstr. 1825/1948) and of Venkateswaren (Proc. Indian Acad. Sci. A, Vol. 15, 322, 362, 371, 1942) the latter being suitably corrected for stray light. Of the nine liquids all except benzene approximately confirm it. G.F.Lothian

535.515

4249. DISPERSION OF THE BIREFRINGENCE OF ROCHELLE SALT IN THE VISIBLE AND THE NEAR INFRARED.
A.M.Vergnoux, J.Blanc and R.Vierne.
C.R. Acad. Sci. (Paris), Vol. 244, No. 5, 580-2 (Jan. 28, 1957).
In French.

The three principal birefringences have been obtained over the wavelength range 0.47 μ to 1.90 μ on three plates having faces parallel respectively to the planes of symmetry of the crystal. The temperature is 20^0. The results are given graphically. The crystal is uniaxial at 1.39 μ. The birefringences at wavelength 5893 A are 0.00119, 0.00536 and 0.00648. These disagree with older measurements but have been verified by contemporary workers. H.G.Jerrard

535.55 : 531.259

4250. STRESS-OPTIC DISPERSION IN GLASSES.
S.Ramaseshan and V.Sivaramakrishnan.
Curr. Sci., Vol. 25, No. 8, 246-8 (Aug., 1956).

A relationship is found for the stress-optic coefficient and the dispersion formula for the material. Examination of the measured values for quartz and glass, whose Drude dispersion coefficients are known, shows that the stress-optic dispersion arises from both a frequency shift and a change in the oscillator strength caused by the strain. R.W.Fish

535.55

4251. APPLICATION OF TWO ULTRASONIC METHODS TO THE DETERMINATION OF THE RATIO p/q OF THE PHOTOELASTIC CONSTANTS OF OPTICAL GLASSES. H.F. Gates and E.A.Hiedemann.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1222-7 (Nov., 1956).

The ultrasonic methods of Bergmann and Fues and of Mueller for the determination of the ratio p/q of the photoelastic constants of glasses were applied to a series of American optical glasses and to fused silica. Mueller's method gave significant results which are given in tables. A.

535.565

4252. THEORY OF THE NATURAL OPTICAL ACTIVITY OF MOLECULAR CRYSTALS. I. CLASSICAL THEORY.
V.M.Agranovich.
Optika i Spectrosk., Vol. 1, No. 3, 338-47 (1956). In Russian.

Theoretical paper. The S.Chandrasekhar formula is obtained for crystals of any symmetry where the constituent molecules are inactive in gas phase or solution. C.R.S.Manders

535.64

4253. ANALYTICAL APPROXIMATIONS FOR COLOR METRIC COEFFICIENTS. D.L.MacAdam.
J. Opt. Soc. Amer., Vol. 47, No. 4, 268-74 (April, 1957).

On the assumption of a colour space of constant negative curvature, von Schelling has given simple formulae for the colour metric coefficients. An attempt has been made to fit such formulae to newly available colour-discrimination data for 12 normal observers. A least-squares analysis indicates that Y should be replaced with the quantity, $Y' = Y - 0.085X + 0.011Z$, in the special role assigned to luminance by von Schelling. Corresponding to this change, coordinates $x' = X/(X + Y' + Z)$, $y' = Y'/(X + Y' + Z)$ yield the simplest formulae for the coefficients of the expression for colour difference:

$$\Delta S = (g_{11}\Delta x'^2 + 2g_{12}\Delta x'\Delta y' + g_{22}\Delta y'^2 + g_{33}\Delta Y^2/Y^2)^{1/2}.$$

Least-squares fitting of the experimental data to von Schelling's formulae yielded:

$$g_{11} = g_{33}/(10x'^2 - 6.886x' + 2.083 + 2.5y' - 16.66x'y' + 19.6y'^2).$$

$$g_{12} = g_{11}(0.3443 - x')/y'.$$

$$g_{22} = g_{11}[0.09 + (0.3443 - x')^2]/y'^2.$$

These formulae are the best approximations obtainable on the assumption of a colour space of constant negative or zero curvature. However, they give such poor approximations to the experimental data that it is concluded that the assumption of a colour space inherently more complicated than a space of constant curvature would be required to fit the data to a closeness commensurate with the experimental reproducibility. A.

535.65

4254. CALCULATION OF C.I.E. COORDINATES OF COLOR TOLERANCE ELLIPSOIDS. A.Opler and M.D.Yeaman.
J. Opt. Soc. Amer., Vol. 47, No. 3, 253-5 (March, 1957).

The loci in C.I.E. space of colours with a given difference from a standard are calculated from the Adams—Nickerson equation. The calculation is carried out by means of a point-by-point transformation from an intermediate chromatic value space to C.I.E. space. Digital computers are used for the entire calculation and transformation. The calculated quasi-ellipsoids may be compared with those observed by Brown and MacAdam. For routine decision work, an approximation involving the intersection of three right cylinders based on projections of the original ellipsoid is employed. A.

535.65

4255. DOVE PRISM VIEWER FOR INVESTIGATION OF SPACE ERROR IN COLOR MATCHING. D.E.Grant.
J. Opt. Soc. Amer., Vol. 47, No. 3, 256 (March, 1957).

A description is given of the optical basis underlying an instrument with which space errors in colour matching have been investigated. R.A.Weale

535.651

4256. GRAPHICAL CONVERSION OF COORDINATES OF CHROMATICITY. A.K.Kustarev.
Svetotekhnika, 1956, No. 5, 4-9. In Russian.

Suggests a simplified method of passing from one system of coordinates to another by means of chromaticity diagrams, without using complicated formulae. The method is based on the projective properties of the chromaticity diagrams, established by Bingley (Abstr. 4441/1954). F.Lachman

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.8 : 531.717.81

4257. TESTING OF GLASS SURFACES BY AN INCIDENT LIGHT SCHLIEREN METHOD. J.R.Meyer-Arendt.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1090-1 (Dec., 1956).

Practical details are given of a microscope attachment allowing

the irregularities of glass or metal surfaces to be deduced from the schlieren pattern. This relatively simple system is said to have advantages over interferometric methods. R.W.Fish

535.8

4258. PRODUCTION OF SINUSOIDAL TEST CHARTS. N.S.Kapany, J.A.Eyer and R.R.Shannon.
J. Opt. Soc. Amer., Vol. 47, No. 1, 103 (Jan., 1957).

A method of making multiple frequency sinusoidal test-charts for use in lens testing is described. An aerial image of a Ronchi ruling is scanned by an integrating device having a sinusoidal mask over the entrance pupil. The brightness of the exit slit then varies sinusoidally. Test charts in the range 3.0 to 0.3 lines per mm have been made. R.W.Fish

535.8 : 537.311.33

4259. TWO OPTICAL INSTRUMENTS USED IN SEMICONDUCTOR RESEARCH. D.G.Avery.
J. sci. Instrum., Vol. 34, No. 1, 16-17 (Jan., 1957).

A single-prism monochromator and a light-spot microscope are described. The monochromator, aperture f3, is intended for low resolution work, and employs a Littrow-mounted prism and a single lens. Typical figures for scattered light intensities at various wavelengths are given. The light-spot microscope, which uses a reflecting objective, provides a spot of light which can be as small as 10 μ in diameter. The spot can be positioned accurately on the semiconductor surface with the aid of two micrometer adjustments; the whole area around the spot is visible through the microscope whilst the instrument is in use. A.

535.81

4260. A FIRST STUDY OF CATADIOPTRIC OBJECTIVES INTENDED AS AN OPTICAL SYSTEM FOR INFRARED RADIATION. C.Morais.
Atti Fond. Ronchi, Vol. 11, No. 1, 48-61 (Jan.-Feb., 1956). In Italian.

A brief description is given of image convertors suitable for transforming infrared into visible radiation. Mirror—lens systems are shown to be particularly useful as objectives for use with such tubes. The equations governing the design of a concentric mirror system are given, and applied to typical arrangements of mirrors and meniscus corrector lenses. R.W.Fish

535.81

4261. TECHNIQUE FOR POLISHING SILVER CHLORIDE PLATES. B.M.Mitzner.
J. Opt. Soc. Amer., Vol. 47, No. 4, 328 (April, 1957).

535.81 : 539.213.2

4262. A STUDY OF GLASSES CONSISTING OF THE OXIDES OF ELEMENTS OF LOW ATOMIC WEIGHT. I. THE LIMITS OF GLASS-FORMING COMPOSITIONS IN BINARY, TERNARY, AND OTHER SYSTEMS OF THE OXIDES OF CERTAIN ELEMENTS OF LOW ATOMIC WEIGHT. II. THE ABSORPTIONS CHARACTERISTIC OF CERTAIN OF THE EXPERIMENTAL GLASSES. III. CERTAIN PHYSICAL AND CHEMICAL PROPERTIES OF THE EXPERIMENTAL GLASSES, IN RELATION TO THE GLASS STRUCTURE. H.Moore and P.W.McMillan.
J. Soc. Glass Technol., Vol. 40, 66T-67T, 68T-96T, 97T-138T, 139T-161T (April, 1956).

A study has been made of glasses melted mainly from binary and ternary mixtures of the oxides of elements of low atomic weight; the basic oxides used were beryllia, lithia, magnesia, and soda, and the acidic or "glass-forming" oxides were boric oxide, alumina, and silica. In some cases the number of oxides was increased to four or more in order to elucidate specific points indicated by the observations made on the ternary mixtures. The limitation to the oxides of the elements of low atomic weight was decided upon because the properties of glasses containing such oxides would, it was considered, be most likely to show variations which could be related to structural changes due to differences between the co-ordination numbers of the different ions.

In Pt I the limits of glass formation in the various systems are described, and deductions are drawn relating to the co-ordination numbers of beryllium and magnesium ions.

In Pt II the transmissions of the glasses in the visible, ultraviolet and infrared regions of the spectrum over the range 230 mμ to 15 μ are dealt with. The transmission curves in the visible and ultraviolet regions showed no absorption except the general absorption in the ultraviolet region due to iron in the ferric condition. In the infrared region the transmission of specimens 2 mm thick was practically zero at and beyond 6 μ, and in some cases was only very small beyond 3 μ. With very thin films, however, the positions of absorption bands over the whole range to 15 μ could be determined, and these could be attributed to different cation—oxygen systems in the glasses; one result given by this study was that in alkali borates and glasses of high boric oxide content the proportion of BO_4 units cannot exceed one-fifth of the total boron—oxygen groups.

In Pt III observations on the densities, coefficients of thermal expansion, and chemical durabilities of a number of the glasses are described and the variations of these properties are correlated with the conclusions drawn from the work described in Pt I and II. A.

535.825.2

4263. SCHLIEREN METHOD FOR MASS DETERMINATIONS IN MICROSCOPIC DIMENSIONS. J.R.Meyer-Arendt.
Rev. sci. Instrum., Vol. 28, No. 1, 28-9 (Jan., 1957).

Discusses the principle and gives some formulae that can be used for computing from schlieren effects the refractive index, the mass concentration, and the anhydrous mass of microscopic particles such as cells or cell constituents. A.

535.89 : 778.34

4264. DARK-FIELD MICROSCOPIC ILLUMINATION FOR ENERGY MEASUREMENTS OF FAST NEUTRONS WITH PHOTOGRAPHIC EMULSIONS. L.Medveczky and E.Bujdosó.
Acta phys. Hungar., Vol. 6, No. 3-4, 349-52 (1957).

By applying an azimuth diaphragm to the aperture iris of a bright-field condenser and thus producing dark-field illumination, a large part of the emulsion volume was made readily visible. Only the tracks of $\pm 25^0$ azimuthal angle interval were observable, that is about 28-30% of all the existing tracks. In case of low neutron intensity, this method facilitates the scanning of tracks in the emulsion as well as their measurement. A.

HEAT 536

536.2.02

4265. TWO-DIMENSIONAL PROBLEMS IN THE THEORY OF THERMAL WAVES. B.G.Korenev.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 1, 29-32 (1957). In Russian.

The propagation of heat in thin plates is studied on the assumption that the temperature is a sinusoidal function of the time. This time dependence is supposed to originate in periodic generation of heat in the interior or the contour of the plate. The differential equation of thermal conduction is solved in accordance with above assumptions and various boundary conditions applicable to the plane surfaces of the plate. Attention is drawn to the analogy with certain problems in elasticity. R.Eisenschitz

536.2.08

4266. THERMAL CONDUCTION AND GAS ANALYSIS. S.C.Saxena.
Nature (London), Vol. 178, 1462 (Dec. 29, 1956).

The well known hot-wire method devised by Daynes and Shakespeare has not always been applied in a manner free from objection. A procedure is outlined which aims to eliminate or make easily calculable the following corrections: wall effect — calculated to be small or negligible according to the gas; convection — eliminated by cell design; radial flow — the only factor requiring calibration; radiation — a fixed correction; temperature drop — negligible in the pressure range 6-20 cm mercury. E.H.Dock

536.23.08

4267. THERMAL CONDUCTIVITY OF BINARY AND TERNARY RARE GAS MIXTURES. B.N.Srivastava and S.C.Saxena.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 369-78 (April, 1957).

The thermal conductivity of the binary gas mixtures Ne--A, Ne–Kr and A–Kr has been measured at 38^0 C for various concentrations by using the "thick-wire" variant of the "hot-wire" method. These data are likely to be of great use for gas analysis in the usual experiments on diffusion and thermal diffusion and have, therefore, been represented by semi-empirical equations giving the conductivity over the entire range of concentration. The experimental values of thermal conductivity have been compared with those calculated on the Lennard-Jones 12-6 model and the modified Buckingham exp-six model. A simple modification of the Lindsay--Bromley formula has been suggested and is found to reproduce the experimental data extremely well. The thermal conductivity of the ternary mixture Ne--A--Kr has also been measured for different compositions of the mixture. A.

536.212.2 : 537.312.62 : 537.311.31

4268. SCATTERING OF PHONONS AND ELECTRONS BY IMPERFECTIONS IN A METAL. K.Mendelssohn and H.Montgomery.
Phil. Mag. (Eighth Ser.), Vol. 1, No. 8, 718-21 (Aug., 1956).

The effect of impurities and of plastic deformation on the thermal and electrical conductivities of lead have been studied between 1 and 4°K. Slight plastic deformation of a Pb specimen (containing 0.5 atomic % Tl) produced no change in the electrical conductivity, σ, nor in the thermal conductivity for the normal state, K_n. The thermal conductivity in the superconducting state, K_s, was however reduced. A comparison of single crystals of pure Pb and of Pb containing 1 atomic % Bi showed that impurities cause a large reduction in σ and also in K_n; K_s is unaffected below 1.4°K although it is decreased at temperatures above that. A qualitative explanation in terms of the different scattering of electrons and phonons by impurity atoms and dislocations is given. A.B.Lidiard

536.24

4269. EFFECT OF AN AXIAL CAVITY ON THE TEMPERATURE HISTORY OF A SURFACE HEATED SLAB. J.I.Masters and S.Stein.
Rev. sci. Instrum., Vol. 27, No. 12, 1065-9 (Dec., 1956).

A theoretical study is made of the surface temperature of a front heated slab in the presence of small holes drilled to within a fraction of a centimetre of the heated surface. In addition, equations and calculations are presented which yield an estimate of the error incurred when the surface temperature is measured by a transducer located at the end of such a hole. In the absence of a practical exact solution to the problem, the method of attack chosen here leads to an upper bound on the additional surface temperature or hot spot caused by a cavity. The upper bound is justified because it is a close upper bound and, for cavity dimensions in the range of interest, the resulting hot spot is quite small. It is shown, for instance, that a $\frac{1}{2}$ mm hole drilled to within 1 mm of the exposed surface will cause a time variant surface hot spot that is no more than 1.5% of the surtemperature. If the hole depth is reduced to $\frac{1}{2}$ mm, then the hot spot is less than 5.5% of the surface temperature. An additional finding is that the magnitude of the hot spot is nearly independent of the temporal shape of the surface heat pulse for a large variance in the latter. A.

536.35 : 536.241

4270. EFFECTIVE USE OF RADIATION AND THERMAL SHIELDS IN A VACUUM FURNACE. Y.Ishikawa and S.Sawada.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1184-90 (Nov., 1956).

A method for calculating the efficiency of several sheets of thick radiation shields with finite thermal conductivity is presented. It is shown that in case of shields having infinite conductivity, the efficiency and temperatures of the shields are expressed by simple formulae. It is shown by several examples of this method of calculation that the most important factors for the efficiency are found to be emissivity, thermal conductivity of the innermost shield and its position. Effectiveness of a shield with small conductivity, which is called "thermal shield" in this paper, especially at high temperature is emphasized. Several experimental results are shown; they agree satisfactorily with the calculations. A.

536.413

4271. THERMAL EQUILIBRATION IN $MgCd_3$ AT LOW TEMPERATURES. T.D.Brotherton, W.E.Wallace and R.S.Craig.
J. chem. Phys., Vol. 25, No. 6, 1297 (Dec., 1956).

Reports results of measurements of the axial ratio c/a between 200° and 350°K. The ratio was found to remain constant at about 0.806 below 268°K, but increases at higher temperatures. This variation accounts for thermal relaxation phenomena observed between 280° and 375°K. Similar phenomena observed between 190° and 240°K are ascribed to changes of the order parameter. E.P.Wohlfarth

536.421.1

4272. VOLUME CHANGE ON MELTING OF N_2 UP TO 3500 kg/cm^2. E.R.Grilly and R.L.Mills.
Phys. Rev., Vol. 105, No. 4, 1140-5 (Feb. 15, 1957).

New and more accurate measurements were made of the volume change on melting of N_2 up to 3500 kg/cm^2. Liquid density and thermal expansion were also studied along the melting curve. A low-pressure metering system was used throughout. The ΔV_m data were fitted to the empirical equation, $\Delta V_m = A - B \log_{10}(P+C)$, with success. Combination of this equation with the authors' previously reported melting equation yields expressions for ΔS and ΔH of melting useful up to 3500 kg/cm^2. A.

536.422

4273. EFFECT OF ELECTRIC FIELD ON THE PHASE TRANSITION OF AMMONIUM SULFATE. K.I.Kamiyoshi.
J. chem. Phys., Vol. 26, No. 1, 218-19 (Jan., 1957).

The temperature of the transition, determined by measuring the temperature variation of the dielectric constant, was found to be affected by a d.c. electric field when the latter was applied along [110] direction but not when the field was applied along the c axis. W.Good

536.423.4 : 536.423.1

4274. THERMO-HYGROMETRIC METHODS OF DETERMINING THE CONCENTRATION OF WATER VAPOUR IN THE BOUNDARY LAYER. N.F.Dokuchaev.
Zh. tekh. Fiz., Vol. 26, No. 10, 2348-55 (1956). In Russian.

Illustrated description of (1) a hair-type hygrometer (hair length 5 mm or more, hair thickness 0.05 mm) with the relative humidity range 0-100%, temperature range from −30 to +50°C, maximum error 5%, and a good reproducibility of results, and (2) a micro-thermopsychrometer, with a wet and a dry thermocouple, characterized by a very small time lag (the whole measurement lasts 15-45 sec). These instruments were used (a) for preliminary experiments on the distribution of vapour pressure and temperature in the boundary layer during the condensation of water vapour on the liquid water surface, the curves obtained bearing out the correctness of the fundamental assumption of the linear variation of vapour concentration in the boundary layer, and (b) for experiments on the evaporation of water (forced convection) at different evaporation rates (0.121-5.730 kg/m^2 hour) and surface temperature (8.1-46.6°C), the ambient air being at 18°C and 65% r.h. Measurements were made as a rule at 20 points across a layer 15 mm thick. Results obtained by means of both instruments for r.h., absolute humidity and temperature at different heights above water surface form smooth lines. Coefficients of diffusion derived from the results of measurements agree with those found in tables. The calculated relationships for Nusselt's temperature and diffusion criteria agree with those found by other authors. F.Lachman

536.461

4275. LIMITS OF STABLE FLAME PROPAGATION IN GASES OF VARIABLE PRESSURE. D.I.Abugov.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 1, 86-9 (1957). In Russian.

A theoretical discussion of flame propagation in gas mixtures containing fine and coarse-grained turbulence, and particularly in piston engines, where the gas pressure changes rapidly with time. R.C.Murray

536.461.08

4276. APPLICATIONS OF THE ELECTRONIC PROBE TO THE STUDY OF TURBULENT FLAMES. D.W.Denniston, Jr, J.R.Oxendine, D.H.Knapschaefer, D.S.Burgess and B.Karlovitz.
J. appl. Phys., Vol. 28, No. 1, 70-5 (Jan., 1957).

Description is given of a negatively biased bare-wire probe with suitable amplification and pulse-height discrimination to be used in detecting flame-fronts in turbulent motion. Typical measurements are given of a Bunsen flame's most probable position, its r.m.s. displacement from this position, and its degree of continuity during unstable burning. The treatment of data and the precision and limitations of the method are discussed. A.

536.48

4277. THERMAL CONTACT AND INSULATION BELOW 1°K. J.C.Wheatley, D.F.Griffing and T.L.Estle.
Rev. sci. Instrum., Vol. 27, No. 12, 1070-7 (Dec., 1956).

Experiments on rapid thermal contact with a single crystal of ferric ammonium alum are discussed and the heat flow rates fitted to the empirical formula $\dot{Q} = \frac{1}{2}aA(T_H^n - T_C^n)$. Thermal links of crystalline quartz and 99.999% copper and bonding agents of GE 7031-Toluene and Apiezon J oil were used and gave substantially the same results with a $\cong 10^4$ erg/(sec cm^2 K^{on}) and $n \cong 2.5$. The heat flow rates have also been measured for a strand of No. 40 copper wire 55 mm long, and for a bundle of ten glass tubes, each 50 mm long, 2.0 mm diameter, and 0.19 mm wall thickness. These data were fitted to the formula $\dot{Q} = BT_H^n$. For the copper and for a single glass tube one finds, respectively, B = 28 and 0.95 erg/(sec K^{on}) and n = 1.7 and 2.6. Solid and gaseous conduction, radiation, and vibration, the four main problems in thermal insulation below 1°K, have also been studied. Guiding principles have been established for the design of sample holders yielding reproducibly low heat leaks. A sample holder is discussed in which an ultimate heat leak of 1.6 erg/min was obtained. The techniques developed have been applied to the design and construction of a simple two-stage adiabatic demagnetization apparatus for use with single crystals. A.

536.48

4278. ENERGY SPECTRUM OF He^3 ADMIXTURES [WHICH ARE] DISSOLVED IN He II. N.G.Bereznyak and B.N.Esel'son.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 2, 322-4 (1956). In Russian.

The density of the normal component in a 3% solution of He^3 is determined as in the experiment of Andronikashvili. The apparatus contains 53 vanes 0.015 cm apart. Test measurements with pure He^4 are in agreement with known data. The relative density of the normal component is measured over a range of approximately 0.75 deg. The increment in the relative density which is due to the admixture of He^3 is found to be independent of the temperature. On account of this, the effective mass of the He^3 atom is derived and found to be 2.5 times the atomic mass.

R.Eisenschitz

536.48

4279. DENSITY OF THE NORMAL COMPONENT IN SOLUTIONS OF HELIUM ISOTOPES. N.G.Bereznyak and B.N.Esel'son.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 902-3 (1956). In Russian.

Experiments described in an earlier paper (see preceding abstract) are extended to solutions of 5.6 and 8.2% of He^3. The effective mass of He^3 is now given, taking into account all available measurements, as 3 times the atomic mass. R.Eisenschitz

536.48

4280. λ-TEMPERATURES OF SOLUTIONS OF HELIUM ISOTOPES. B.N.Esel'son, N.G.Bereznyak and M.I.Kaganov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 3, 568-70 (1956). In Russian.

Thermodynamic equilibrium conditions are applied to the saturation pressure of He^3—He^4 mixtures. The existence of a kink in the pressure temperature curve at the λ-point is established, both for the total and the partial pressures. There is, however, no kink for pure He^4. Experiments with concentrations up to 38.3% clearly show the kink. It is used for determining the transition temperature. The resulting λ-point—concentration curve is smooth but does not agree well with the known curves obtained by direct determination. It is pointed out that the result can be theoretically obtained from the density of the normal component.

R.Eisenschitz

536.48

4281. THE SPECIFIC HEAT OF LIQUID HELIUM. R.W.Hill and O.V.Lounasmaa.
Phil. Mag. (Eighth Ser.), Vol. 2, 143-8 (Feb., 1957).

New measurements of the specific heat of liquid helium between 1.80 and 5.05°K are presented, and some of their consequences for the helium vapour-pressure scale of temperature discussed. A.

536.48 : 532.13

4282. HYDRODYNAMICS OF OSCILLATING DISKS IN VISCOUS FLUIDS: DENSITY AND VISCOSITY OF NORMAL FLUID IN PURE He^4 FROM 1.2°K TO THE LAMBDA POINT. J.G.Dash and R.D.Taylor.
Phys. Rev., Vol. 105, No. 1, 7-24 (Jan. 1, 1957).

A new study has been made of the viscous component in liquid He II, using the experimental method of Andronikashvili. The hydrodynamic equations for disks oscillating in a viscous medium have been derived from first principles in a form amenable to experimental test of the necessary approximations. Associated studies with several ordinary liquids have yielded an empirical constant for the liquid dragged by the disk corner. The final semi-empirical equations of motion appear to provide a significantly better approximation than those previously published. The new formulae have been applied to a combined study of density and viscosity of pure He^4 liquid from 1.2°K to the lambda point, 2.1735°K. Refinements in experimental technique include larger oscillating systems, improved temperature regulation and measurement, and precision chronometry. The theoretical roton temperature dependence of Landau and of Feynman provides a good description of the density between 1.2° and 2.0°K. The empirical value of the roton excitation energy is found to be $\Delta/k = 10.60$°K. Detailed investigation in the region of the lambda point shows an accelerated rise in the normal fluid density above 2.0°K; the temperature derivative of density tends toward infinity at T_λ. The data confirm the measurements made earlier by Andronikashvili over the entire temperature range. At temperatures below 1.5°K the torsion pendulum results lie significantly lower than those derived from second sound and specific heat data. Viscosities of the normal fluid are in substantial agreement with the earlier results of Andronikashvili and with the viscometer values of Heikkila and Hallett down to 1.5°K. Discrepancies between the oscillating disk and viscometer data below 1.5°K have not been resolved. The temperature dependence of the viscosity near the lambda point indicates that T_λ is a point of strong singularity for both viscosity and normal fluid density. A.

536.48

4283. SUPERPOSITION (DOUBLE-LIFE) MODEL OF LIQUID HELIUM. W.Band and R.Singh.
Phys. Rev., Vol. 105, No. 4, 1145-50 (Feb. 15, 1957).

London's idea of representing the liquid state by a superposition of phonon and translational modes of motion is generalized. The superposition procedure is given a rigorous quantum mechanical basis, and a statistical mechanical method is used to derive the superposition ratio for both isotopes of liquid helium; the ratio is correlated successfully with the thermodynamic data. A.

536.48

4284. PECULIAR PROPERTIES OF ROTATING He II. B.N.Esel'son, B.G.Lazarev, K.D.Sinel'nikov and A.D.Shvets.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 912 (1956). In Russian.

In Andronikashvili's experiment (angular oscillations) there is no drag on the superfluid component; in a beaker rotating at uniform velocity the superfluid component is held moving together with the normal component. This discrepancy might be explained by a large relaxation time associated with the drag on the superfluid component. In order to test this assumption a beaker with liquid helium is suspended magnetically. It is set in rotational movement by a transient rotating magnetic field. Assuming that initially the superfluid component stays at rest and starts moving after the relaxation time has elapsed, the moment of inertia of the beaker would gradually increase; this would show by a decrease in angular velocity. The authors state that the observed deceleration is not sufficient for establishing the above effect; they conclude that the relaxation time in their experiment is shorter than two seconds. R.Eisenschitz

536.483 : 538.24

4285. THERMAL EQUILIBRIUM IN NUCLEAR MAGNETIC COOLING OF METALS. C.Kittel.
Phys. Rev., Vol. 104, No. 6, 1807-8 (Dec. 15, 1956).

In the nuclear demagnetization of Cu by Kurti et al. (Abstr. 2137/1957) the nuclear spin system was cooled from 10^{-2} °K to 2×10^{-5} °K. It is shown that the conduction electrons and lattice should cool to almost the same temperature in about 1 sec, even though the relevant relaxation time is about 10^5 sec at 10^{-5} °K: because of the very small specific heat of the electrons, only a minute proportion of the spins have to relax to produce equilibrium.

R.G.Chambers

536.49

4286. THE MOTION OF INCLUSIONS IN A SOLID. A.A.Chernov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 709-10 (1956). In Russian.

An inclusion situated in an infinite isotropic solid is considered. The inclusion is assumed to have spherical form and to be filled with gas or liquid in which the solid material is notably soluble. If there is a temperature gradient maintained in the system then motion of the inclusion is due differences in the saturation concentrations of the solutions in the cold and hot sides of the inclusion and the resultant transfer of material within it. An expression is derived for the velocity of motion of the inclusion in terms of the thermal parameters of the inclusion and solid. The velocity is independent of dimensions of the inclusion and its direction depends on whether $dc/dt < 0$, where c = concentration, t = temperature. For a temperature gradient of 1 deg/cm a displacement velocity may be of the order 0.1 mm/day. C.R.S.Manders

536.5.081.3 : 536.48

4287. THE BATTLE OF THE MILLIDEGREE. W.E.Keller.
Nature (London), Vol. 178, 883-7 (Oct. 27, 1956).

A critical assessment of the two recently proposed temperature scales which relate the vapour pressure of He^4 to the absolute temperature, viz. $T_{55}E$ by J.R.Clement and T_{L55} by H.van Dijk and M.Durieux. $T_{55}E$ is based on gas thermometer measurements, interpolated with measurements of the vapour pressure by carbon resistors and paramagnetic salts. It is analytical in form, consisting of two branches which join at the λ-point with a discontinuous d^2p/dT^2. T_{L55} below 4.167°K is derived from a vapour-pressure equation which is thermodynamic in form, involving the latent heat at absolute zero, the entropy of the liquid and the second virial coefficient of the gas. Above 4.167°K a slight modification of the original Berman-Swenson equation is used. This results in a discontinuity of d^2p/dT^2 at 4.167°K. Below 4.2° the two scales differ by at most 0.0036°K, but above 4.2° the difference increases to 0.012°K at 5.2°K. If the latent heat and entropies are calculated from $T_{55}E$, values result which fall within the limits of error of the measurements on which T_{L55} is based. It would be therefore possible to obtain values of entropy etc. consistent with $T_{55}E$ and re-write this scale in thermodynamic form. $T_{55}E$ avoids the unwarranted discontinuity of d^2p/dT^2 at 4.167 and is also preferred as it yields a λ-point vapour pressure which is in closer agreement with recent measurements. H.London

536.5 : 536.42

4288. DISTRIBUTION OF HEAT IN A TWO-PHASE SYSTEM FOR A SPECIFIED EQUATION OF MOTION OF THE PHASE BOUNDARY. G.A.Martynov.
Zh. tekh. Fiz., Vol. 25, No. 10, 1754-67 (1955). In Russian. English translation in: Atomic Energy Res. Establ. (Harwell) Transl. 710, 16 pp. (1956).

Since the systems of integral equations for the direct Stefan problem are always very difficult to solve, even numerically, the inverse Stefan problem is studied. For a given equation of motion of the phase boundary and initial temperature distribution, the temperatures at the stationary phase boundary and in the medium are determined. It is shown that this inverse problem has a unique solution in all cases. The author also deals with the setting up of the initial integral equations for the Stefan problem by the extension method, for equations of a parabolic type. R.C.Murray

536.581.3 : 535.34.07

CRYOSTAT FOR SPECTROPHOTOMETRIC MEASUREMENTS. See Abstr. 4143

536.587

4289. A SYSTEM FOR CONTROLLED LINEAR COOLING OF LABORATORY FURNACES. T.W.Lomas and L.G.Finch.
J. sci. Instrum., Vol. 34, No. 3, 118-20 (March, 1957).

A synchronously-driven resistance bridge network has been developed which, when used with a suitable proportioning temperature controller will control linearly the heating or cooling of a small laboratory furnace within the range 6 to $\frac{1}{12}$ deg C/min. The theory and design of the unit are described. A.

536.631 : 537.312.62

4290. ATOMIC HEATS OF NORMAL AND SUPERCONDUCTING THALLIUM. J.L.Snider and J.Nicol.
Phys. Rev., Vol. 105, No. 4, 1242-6 (Feb. 15, 1957).

The atomic heats of thallium have been measured in the liquid helium temperature range. In the normal state the atomic heat varies with temperature according to the form: $C_n = \gamma T + 464.4(T/\theta)^3$ cal/mole deg in which $\gamma = 6.11 \times 10^{-4}$ cal/mole deg^2 and $\theta = 86.6^0$. In the superconducting state, at temperatures below $0.9\,T_c$, the electronic specific heat obeys the relationship: $C_{SE} = \gamma T_c A \exp(-\alpha T_c/T)$ cal/mole deg., in which $A = 5.8$ and $\alpha = 1.3$. These results lend support to the suggestion made in consequence of recent measurements of the atomic heats of aluminium, vanadium, and tin that the electronic specific heat may in general be an exponential function of temperature. They do not confirm, however, the suggestion that there exists a law of corresponding states among superconductors. A.

536.654 : 539.219

4291. CHANGES IN THE PARTIAL VALUES OF THERMODYNAMIC QUANTITIES FOR IRON IN SOLID IRON–CHROMIUM ALLOYS. L.I.Ivanov and M.P.Matveeva.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1271-3 (1956). In Russian.

The heat of sublimation of iron from iron–chromium alloys, worked out from measurements of rates of evaporation of iron by a radioactive tracer technique, passes through a maximum at 50% iron, of about 156 kcal/g-atom of iron (α solid solution) and through a minimum of about 80 units at about 90% chromium, in the γ solid solution range. There is a minimum at about 60% iron on the activity–composition curve, indicating the formation of sigma-phase at low temperatures. Corresponding to this, there is flat maximum at about the same region on the centrifugal deflection–composition curve (measurement of "hot strength"). R.C.Murray

THERMODYNAMICS 536.7/.8

536.7

4292. PROPERTIES OF THE SHOCK TRANSITION AT LOW TEMPERATURE. J.J.Gilvarry.
J. appl. Phys., Vol. 27, No. 12, 1467-72 (Dec., 1956).

Bethe's equation for the change of entropy in waves of finite amplitude is shown to be inapplicable for an initial state of temperature arbitrarily close to absolute zero, for a degenerate substance possessing a zero-point pressure (or energy). Thermodynamic functions for such a substance at low temperature are formulated in general terms applicable to the Fermi–Dirac gas, the Thomas–Fermi atom, the Debye solid, and the Mie–Grüneisen solid as special cases. The conditions under which the equation of state satisfies the Bethe–Weyl conditions are given. Of the usual four basic properties of the shock transition under the Bethe–Weyl conditions, two must be modified for the class of substances in question, for an initial state arbitrarily close to zero temperature. The argument follows from extension of Bethe's method, by Taylor expansion of the Hugoniot function about the initial state. The results are shown to be consistent with Weyl's procedure. A.

536.7 : 530.162

FLUCTUATIONS AND IRREVERSIBLE THERMODYNAMICS. See Abstr. 3990

536.75

4293. THERMODYNAMIC FUNCTIONS OF SOME SIMPLE FLUORINE COMPOUNDS. R.L.Potter.
J. chem. Phys., Vol. 26, No. 2, 394-7 (Feb., 1957).

The thermodynamic functions of F(g), F_2(g), H^1F(g), D^2F(g), and the naturally occurring isotopic mixture of H^1F(g) and D^2F(g) have been calculated for these substances in the ideal gas state from 298.16^0K to 5000^0K by standard methods of statistical mechanics using available spectroscopic data. A.

536.75

4294. LATTICE ENTROPIES — ENTROPIES OF VAPORIZATION OF IONS FROM CRYSTALS. A.P.Altshuller.
J. chem. Phys., Vol. 26, No. 2, 404-6 (Feb., 1957).

The entropies of vaporization of salts, the lattice entropies, have been calculated for salts containing both monatomic and polyatomic ions. The variations of the lattice entropies of these salts with valence type are discussed. The effects of ion size and ionic character on the lattice entropies also are considered. The entropies of vaporization of single monatomic and polyatomic ions also have been computed. The effects of ion size, charge on the cation and anion, size of the central atom in oxy-anions, and the number of oxygen atoms attached to the central atom of the oxy-anions all are discussed. The lattice entropies of monatomic salts should depend on the change from vibrational modes in the solid to translational modes in the gas. The lattice entropies of polyatomic salts depend in a complicated manner on the internal modes of motion in the gaseous polyatomic ions and in the solid. A.

ELECTRICITY 537

537.121

4295. EXPERIMENTAL LIMIT FOR THE ELECTRON–PROTON CHARGE DIFFERENCE. V.W.Hughes.
Phys. Rev., Vol. 105, No. 1, 170-2 (Jan. 1, 1957).

By a study of the deflection of a beam of CsI molecules in a homogeneous electric field an upper limit is established for the charge on a CsI molecule. This upper limit is 1.7×10^{-22} e.s.u. or 4×10^{-13} of the electronic charge, and implies that the magnitude of the electron–proton charge difference is less than 3×10^{-15} of the electronic charge or that the charge on a neutron is less than 2×10^{-15} of the electronic charge. A.

537.122

4296. THE EQUATIONS OF THE MAGNETIC ELECTRON DEDUCED FROM THE THEORY OF QUADRUPLE FIELDS. A.Aymard.
C.R. Acad. Sci. (Paris), Vol. 243, No. 16, 1100-2 (Oct. 15, 1956). In French.

It is shown that, with a suitable choice of Lagrange density, the required equations follow from the theory of tetrad fields (Abstr. 2977/1957). R.A.Newing

ELECTROSTATICS. DIELECTRICS 537.2

537.213 : 537.533.2

4297. ROTATING ELECTROMETER FOR COMPARATIVE WORK FUNCTION MEASUREMENTS. H.H.Kolm.
Rev. sci. Instrum., Vol. 27, No. 12, 1046-8 (Dec., 1956).

An apparatus for measuring work functions by the Kelvin method is described in which the customary vibrating motion is replaced by rotary motion. A set of three coplanar samples is mounted on a turntable which rotates below a set of three stationary samples. This arrangement permits a simultaneous observation of three elec-

trode pairs in all permutations and provides ready access to the sample surfaces for purposes of treatment, illumination, inspection, etc., without the necessity for repositioning. The rigid structure also permits the application of electrostatic fields between electrodes, which is difficult in a vibrating system. Measurements can be made in high vacuum by driving the turntable inductively with coils located outside the glass envelope. The instrument has a sensitivity of ±1 millivolt. A.

537.221

4298. AN IMPROVED TECHNIQUE FOR THE MEASUREMENT OF CONTACT POTENTIAL DIFFERENCES. K.A.MacFadyen, and T.A.Holbeche.
J. sci. Instrum., Vol. 34, No. 3, 101-5 (March, 1957).

A development of the vibrating-condenser method is described. It is used for the measurement of contact potential-difference between a standard electrode and an area of about 1 mm^2 of a metal surface immersed in an insulating liquid. Discrimination against circuit noise is achieved by homodyne rectification. A novel form of drive for the vibrating-condenser is used. Contact potential differences may be measured to an accuracy of 0.1 mV. A.

537.222

4299. STUDY OF LICHTENBERG'S FIGURES BY MEANS OF SPECIAL DRY PLATES. B.Arai.
Sci. Rep. Yokohama Nat. Univ. I, 1955, No. 4, 59-64.

The plates included some with varied emulsion ageing, with desensitizer, and with KNO_3 additions to alter conductivity; also types for nuclear, radiographic and electron work. Experiments are described and about 75 photographs shown. S.T.Henderson

537.226.1

4300. DIPOLE MOMENT FLUCTUATIONS OF A DIELECTRIC BODY. B.K.P.Scaife.
Proc. Phys. Soc. B, Vol. 70, Pt 3, 314-19 (March, 1957).

Fröhlich's theory of dielectrics has shown that a dielectric body will exhibit spontaneous fluctuations in dipole moment as a result of thermal agitation. It is pointed out that these fluctuations may arise from a variety of sources and that each source is intimately connected with a particular mechanism of polarization. The particular case of a dielectric which has two mechanisms of polarization (orientational and displacement) is considered. Fröhlich's relations for the total mean square fluctuation in dipole moment of a dielectric sphere are modified so as to yield an expression for the fluctuations arising from only one polarization mechanism (the orientational). It is shown that Fröhlich's free energy method of computing these fluctuations is independent of the dynamic properties of the dielectric. The recent work of Harris and Alder (Abstr. 6030/1953; 928/1955) is shown to be in error. A.

537.226.2

4301. DIELECTRIC BEHAVIOUR OF MIXTURE OF POLAR GASES AT MICROWAVE FREQUENCIES. G.P.Srivastava.
Curr. Sci., Vol. 25, No. 4, 111-12 (April, 1956).

The 3 cm wavelength dielectric constants of gas mixtures of CH_3Br and C_2H_5Cl with NH_3 are observed to be exactly those to be calculated from the partial pressures and additivity in $(\epsilon - 1)$.

D.H.Whiffen

537.226.2 : 548.7

4302. DIRECTIONAL EFFECTS IN THE ELECTRIC BREAKDOWN OF SINGLE CRYSTALS OF KCl AND NaCl. R.Cooper, D.T.Grossart and A.A.Wallace.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 169-76 (Feb., 1957).

In alkali halide crystals the discharge paths formed when electric breakdown occurs about a point electrode follow definite crystallographic directions, but many believe that the intrinsic electric strength of these materials does not depend on the direction of the applied field. This belief is difficult to reconcile with the above fact and examination of the literature shows that it is based on very scanty evidence. The experiments described in this paper were made to extend the available information, and measurements of intrinsic strength were made with both KCl and NaCl between -200° C and $+230^\circ$ C. The results of the measurements provide little support for the above belief. A fair measure of agreement existed between the discharge track directions and the directions of smallest electric strength. This result suggests that the mechanism of breakdown is dependent on the properties of high-energy conduction electrons. A.

537.226.2

4303. DIELECTRIC PROPERTIES OF CARBON TETRACHLORIDE, BENZENE AND ORTHO-NITROPHENOL AT HIGH RADIO FREQUENCIES. A.K.Rafiqullah and M.Innas Ali.
Pakistan J. sci. Res., Vol. 8, No. 4, 167-70 (Oct., 1956).

This paper describes an experimental study of the dielectric properties of redistilled carbon tetrachloride, benzene and solution of ortho-nitrophenol in benzene at high radio frequencies namely 108, 143 and 180 Mc/s and over a temperature range 10° C-33° C by transmission line method and the results obtained are analysed. The evidence for dielectric losses of the order of 10^{-4} in magnitude for both carbon tetrachloride and benzene suggests that the infrared absorption bands for these substances need not be too narrow. Measurements on solutions of ortho-nitrophenol in benzene indicate that the Debye model of dipolar rotation does not apply exactly in this case. It is found that the height of potential/energy barrier to be surmounted in dipole rotation is less than that associated with viscous flow. The "frequency factor" (Eyring) for the dipole rotation is also smaller than that for viscous flow. Thus it appears that the molecular jumps over the potential/energy barrier in viscous flow are accomplished more readily than those associated with dipole rotation. There is also evidence that the temperature-independent dielectric constant of the solution may be a function of concentration of dipole molecules and contribute to the "hindered rotation" (Debye) of dipoles. The effective dipole moment of ortho-nitrophenol is evaluated to be 1.28 Debye units and in conformity with this an inclined polar group in the molecular structure is assigned. A.

537.226.2

4304. THE PROBLEM OF DIELECTRIC LOSSES IN SOLID AMORPHOUS STRUCTURES. V.Kh.Kozlovskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 10, 2254-8 (1956). In Russian.

A theoretical study of the losses in pure silicate glasses taking into account the inertia of ions. The frequency dependence of the real and the imaginary parts of the permittivity is calculated.

537.226.2

4305. THE PROBLEM OF LIGHT EMISSION BY DIELECTRICS IN STRONG ELECTRIC FIELDS. A.A.Vorob'ev and V.D.Kuchin.
Zh. tekh. Fiz., Vol. 26, No. 11, 2516-17 (1956). In Russian.

Electric fields, up to 88% of the breakdown value, applied to polystyrene, "plexiglass", and crystals of NaCl, KCl and KBr failed to produce ultraviolet or X-ray radiation. This result is said to be in agreement with the theory of radiationless electron transitions in solids. Description is given of the apparatus for producing and observing (visually, photographically or by means of a photon counter) the expected electroluminescence. This apparatus can be also used for measurement of the electric strength of solid dielectrics.

537.226.2.08

4306. EFFECT OF FRINGING FIELD ON CAPACITANCE AND A MEASUREMENT OF ϵ_0. R.A.Kromhout and W.G.Moulton.
Amer. J. Phys., Vol. 24, No. 9, 631-2 (Dec., 1956).

A teaching laboratory experiment.

537.226.31 : 535.343

4307. PASSING FROM THE RADIOFREQUENCY REGION TO THE INFRARED AND FROM THE INFRARED TO THE RADIOFREQUENCY. P.Abadie, R.Charbonnière, A.Gidel, P.Girard and A.Guilbot.
C.R.Acad. Sci.(Paris), Vol. 243, No. 16, 1110-12 (Oct. 15, 1956). In French.

The energy of hydrogen bonds between adjacent O—H groups in starch, cellulose, sugars etc. may be calculated with good agreement from the variation with temperature of the critical frequency of dielectric loss (Abstr. 3628/1956) or the shift of the frequency of O—H in the infrared. R.C.Seymour

537.226.32

4308. ELECTRICAL CHARACTERISTICS OF THIN ELECTRETS PREPARED FROM CARNAUBA WAX. C.S.Bhatnagar and D.R.Bhawalkar.
Res. Bull. Saugar Univ. Phys. Soc., Vol. 1, No. 1, 10-13 (April, 1956).

Dependence of electric charge on the thickness and the polarizing field has been investigated for electrets prepared from carnauba wax. The results show that for electrets of thickness less than 0.1 cm, the charge per unit area is constant for fields above 1 kV/cm. Electrets above 0.1 cm thickness show a charge 30% higher if the polarizing field is above 10 kV/cm. These results are the same for the three varieties of carnauba wax used. A.

537.226.33

4309. ATTEMPT AT INTERPRETATION OF THE RADIO-FREQUENCY SPECTRUM OF CYCLOHEXANOL. L.Reinisch.
C.R. Acad. Sci. (Paris), Vol. 243, No. 15, 1032-4 (Oct. 8, 1956). In French.

Three dielectric dispersion regions are recognized in cyclohexanol, the mechanisms for relaxation being (i) critical frequency, ν_0, 66 Mc/s at 25° C; activation energy, ΔE, 11.5 kcal/mole relaxing by interconversion between the two chair isomers; (ii) ν_0 =

1000 Mc/s at 25°C, $\Delta E = \sim 8.4$ kcal/mole, relaxing by breakdown of hydrogen bonded regions; (iii) $\nu_0 \gg 1000$ Mc/s relaxing by overall rotation of monomers. D.H.Whiffen

537.226.33

4310. OBSERVATION OF DIELECTRIC RELAXATION AND OF DISPLACEMENT OF THE TRANSITION TEMPERATURE IN AMMONIUM SULPHATE. S.Le Montagner and A.Le Traon.
C.R. Acad. Sci. (Paris), Vol. 243, No. 15, 1034-7 (Oct. 8, 1956). In French.

Permittivity–temperature measurements on powdered $(NH_4)_2SO_4$ show that the transition temperature is raised from 224 to 240°K when absorbed water is removed by reducing the ambient pressure to 10^{-5} mm Hg. The activation energy of the low-temperature phase is about 1.8 eV. (See Abstr. 5066/1956). J.H.Mason

ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.083

4311. MEASUREMENT OF HIGH RESISTANCE. S.W.Leifson.
Amer. J. Phys., Vol. 25, No. 2, 89-92 (Feb., 1957).

A method of measuring a high resistance by means of an inverted triode voltmeter is described. Simple and inexpensive apparatus is used. Complete data for plotting the charge and discharge curves of a condenser may be obtained in a few minutes. Being suitable for the general physics laboratory, the experiment gives students good practice in using and analysing exponential and logarithmic curves. A.

537.311.1 : 539.234

4312. ON THE ELECTRICAL RESISTIVITY OF VERY THIN METALLIC FILMS. G.Darmois.
C.R. Acad. Sci. (Paris), Vol. 243, No. 15,1024-6 (Oct. 8, 1956). In French.

Discussion of experimental results of Mostovetch (Abstr 4797/1953) in terms of a simple model of a granular film (Abstr. 6611/1956). E.H.Sondheimer

537.311.1 : 621.3.011.22

4313. PHENOMENOLOGICAL THEORY OF CONDUCTIVITY. G.Beck.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1190-1 (Nov., 1956).

A brief theoretical note pointing out that a theory of conductivity based on electron interaction with lattice vibrations is necessarily incomplete and proposing the use of a model in which induction effects involving the energy of the magnetic field of the current are taken into account. M.R.Hopkins

537.311.1

4314. THERMAL FLUCTUATIONS IN CONDUCTORS. N.L.Balazs.
Phys. Rev., Vol. 105, No. 3, 896-9 (Feb. 1, 1957).

The behaviour of a conductor in thermal equilibrium with the surrounding radiation field is investigated. An expression is obtained connecting the spectrum of the current fluctuations with the absorption. For small frequencies this reduces to Nyquist's relation. For large frequencies, however, the relation is quite different; namely, the current fluctuations are proportional to the (skin) resistance and depend also on the shape of the conductor. A.

537.311.31 : 537.533.9

4315. ELECTRON IRRADIATION OF COPPER BELOW 10° K. J.W.Corbett, J.M.Denney, M.D.Fiske and R.M.Walker.
Phys. Rev., Vol. 104, No. 3, 851-2 (Nov. 1, 1956).

The change in electrical resistivity in a thin, high-purity copper foil bombarded below 10°K by 1.35 MeV electrons has been measured, and is compared with theoretical estimates. The effect of subsequent annealing has also been studied. E.H.Sondheimer

537.311.31 : 536.212.2

4316. RESISTANCE MINIMUM OF MAGNESIUM: ELECTRICAL AND THERMAL RESISTIVITIES. D.A.Spohr and R.T.Webber.
Phys. Rev., Vol. 105, No. 5, 1427-33 (March 1, 1957).

The thermal and electrical resistivities of two specimens of magnesium have been measured in the temperature range 1.5 to 25°K. One specimen was a spectrographically pure rod of 99.98+% magnesium with 0.013% iron as the major contamination. The second specimen was 99.95+% pure with 0.043% manganese as the only significant contaminant. The electrical resistivity of the purer material passed through a minimum at ~ 5°K and increased by 1.7% as the temperature was lowered to 1.5°K. In the same specimen, the thermal resistivity at the lowest temperature exhibited a positive deviation from normal behaviour (defined by $w = \alpha T^2 + \beta/T$) of the same order of magnitude. Between 5° and 15°K a negative deviation was observed in the thermal resistivity. The electrical resistivity of the dilute manganese alloy specimen passed through a minimum at ~ 14°K and increased by approximately 20% as the temperature was lowered to 1.5°K. An exactly analogous effect was found in the thermal resistivity as evidenced by (1) a constant Lorenz ratio at temperatures below 4°K, and (2) the equality of the percentage deviations of the respective resistivities from normal behaviour over the entire range of measurements. A.

537.311.31 : 536.48

4317. RESISTANCE MINIMUM OF MAGNESIUM: ELECTRICAL RESISTIVITY BELOW 1°K. R.A.Hein and R.L.Falge.
Phys. Rev., Vol. 105, No. 5, 1433-4 (March 1, 1957).

Measurements of the electrical resistivity of the two magnesium specimens described in the preceding abstract have been extended to temperatures below 1°K. At the lowest temperature at which data were obtained (0.22°K), the electrical resistivities of both specimens were continuing to increase. The ratio $\rho_{0.22^\circ K}/\rho_{4.22^\circ K}$ was found to be 1.05 for the purer specimen and 1.24 for the less pure (manganese alloy) specimen. A.

537.311.31 : 536.631

4318. RESISTANCE MINIMUM OF MAGNESIUM: HEAT CAPACITY BETWEEN 3°K AND 13°K. J.K.Logan, J.R.Clement and H.R.Jeffers.
Phys. Rev., Vol., No. 5, 1435-7 (March 1, 1957).

Heat capacities were measured for two samples of slightly impure magnesium identical with those whose transport properties have been measured. Although the samples exhibit markedly different transport properties, any systematic difference in their specific heats was found to be less than 5% in the range of measurement. Atomic heat values were in agreement with earlier measurements on pure Mg in this temperature range. A.

537.311.31 : 538.63

4319. RESISTANCE MINIMUM IN MAGNESIUM: MAGNETORESISTANCE. R.T.Webber.
Phys. Rev., Vol. 105, No. 5, 1437-9 (March 1, 1957).

The magnetoresistance of two specimens of magnesium has been measured at liquid helium temperatures in transverse magnetic fields up to 25 kilogauss. One specimen, containing 0.013% iron as the predominant impurity and previously shown to possess a minimum in the electrical resistivity at 4.5°K, demonstrated a magnetoresistance which followed Kohler's rule quite exactly. The second specimen, containing 0.043% manganese and previously shown to have a rather large negative dR/dT at helium temperatures, showed a small departure from Kohler's rule. The magnetoresistance observed in these specimens is in fair agreement with the majority of results previously reported by Thomas and Mendoza and by Yntema. A.

537.311.31

4320. RESISTANCE VARIATION OF THIN METALLIC FILMS BROUGHT ABOUT BY ABSORPTION OF GASES. (EXPERIMENTS WITH SELF-SUPPORTED SILVER FILMS). S.Tunakan.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 21, No. 1, 16-25 (Jan., 1956). In German.

Specimens of thickness 200 to 1000 mμ with a freely supported region 1 mm x 1 cm were heated to red heat by the currents passed through them and their resistances measured as a function of the surrounding O_2, H_2, or He pressure. In O_2 and H_2 the resistance increases, and the effect does not saturate even after two hours. In He no effect is observed. The relative resistance increase is proportional to the layer thickness and does not decrease on pumping out. The effects are explained in terms of an activated absorption of the two gases. C.A.Hogarth

537.311.31 : 536.212.2

4321. THE THERMAL AND ELECTRICAL CONDUCTIVITIES OF METALS AT HIGH TEMPERATURES. M.R.Hopkins.
Z. Phys., Vol. 147, No. 2, 148-60 (1957). In German.

A method of investigating the electrical and thermal conductivities of metals at high temperatures is described. The theory of the method depends upon the application of ideas which are fundamental in the study of electrical contact phenomena. The ratio of the thermal to the electrical conductivity of platinum has been determined from 1200°C to the melting point (1773°C) and from the melting point to 2300°C by making simultaneous observations of electrical potential and maximum temperature in a short wire through which current is passed. The wire terminates in two blocks of the same

metal, and the ends of the wire are not assumed to be plane isothermal (and equipotential) surfaces. The wire remains in place when partly molten so that observations are extended well into the molten range. The method is independent of the exact geometrical configuration of the conducting system. The details of the arrangement of the apparatus and of the method of temperature measurement are given. The results are discussed in relation to the properties of the molten metal bridges formed between the electrodes of electrical contacts and to the value of the Lorenz factor in the Wiedemann—Franz law. A.

537.311.31 : 537.312.62 : 536.212.2

EFFECT OF IMPERFECTIONS ON ELECTRICAL CONDUCTIVITY OF NORMAL AND SUPERCONDUCTING LEAD. See Abstr. 4268

537.311.32 : 537.226.32

4322. ELECTRICAL CONDUCTIVITY OF CARNAUBA WAX NEAR ITS MELTING POINT. C.S.Bhatnagar and D.R.Bhawalkar.
Res. Bull. Saugar Univ. Phys. Soc., Vol. 1, No. 1, 2-6 (April, 1956).

The steady-current characteristics in d.c. fields are studied for carnauba wax by determining the conductivity (a) at constant field and (b) at constant temperature in the range 70 to 90° C. The curves at constant field show that in the region of temperature 75 to 82° C, the wax is neither in the solid nor in the liquid state. The conductivity at constant temperature is found to be a function of the electric field but the relation is not simple. In the low-field region the curves show a maximum and a minimum at fields which are the same for the liquid and the solid states. These results are partly explained by the constitution of wax and the lattice defects of the solid state. A.

537.311.32

4323. A STUDY OF THE ELECTRICAL CONDUCTIVITY OF MANGANESE—ZINC FERRITE. J.Brož.
Czech. J. Phys., Vol. 6, No. 4, 321-9 (Aug., 1956). In Russian.

The electrical conductivity of manganese zinc ferrite with approximate composition $Mn_{0.45}Zn_{0.45}Fe_{2.1}O_4$ is studied as a function of temperature and external electric field. The dependence of the electrical conductivity of ferrites on the external electric field can be connected with the existence of surface layers on the individual crystal grains. According to this concept the sintered ferrite sample is composed of grains having a fairly high electrical conductivity which are divided from one another by surface layers the conductivity of which is very low. The correctness of this model is borne out by the measurements of the electrical resistance, or dielectric constant, at various frequencies, carried out by a number of authors on various ferrites or on other, similar, materials. The influence of the electric voltage on the conductivity of ferrites has not yet been studied explicitly. It has been found earlier that with small voltages Ohm's law remains valid; at higher voltages the change in conductivity is explained as a result of the sample being heated by the current flowing in it. The results of the measurements show that the change in resistance with the external electric field takes place at very small voltages. By a simple experiment in which two different voltages were alternately applied at small equal time intervals it was found that the change in resistance produced by increasing the voltage cannot, for the ferrite studied, be ascribed to the heating of the sample. The result of measuring the dependence of the electrical conductivity of manganese zinc ferrite on the temperature is shown as the logarithm of the conductivity as a function of the reciprocal temperature. It is seen that for low and medium temperatures this dependence is linear and can be expressed with sufficient accuracy in each of these temperature ranges by the exponential relationship $\sigma(T) = A\exp(-\epsilon/2kT)$. The break in the linear course occurring around room temperature is accompanied by a considerable increase in the constant A while the value of the activation energy ϵ increases much less. A.

537.311.33

4324. SEMICONDUCTING INTERMETALLIC COMPOUNDS. L.Pincherle and J.M.Radcliffe.
Advances in Phys., Vol. 5, 271-322 (July, 1956).

After an introduction on the nature of the experimental data and on the fundamental parameters of semiconductors, a review is given of the information published up to May, 1956 on the semiconducting compounds between elements of the following group pairs I—V, II—IV, II—V and III—V. 250 references. L.Pincherle

537.311.33

4325. PHOTO-MAGNETIC PHENOMENON IN A SEMICONDUCTOR IN A NON-HOMOGENEOUS MAGNETIC FIELD. J.Tauc.
Czech. J. Phys., Vol. 6, No. 5, 421-2 (Oct., 1956).

The e.m.f. which is produced on illuminating a homogeneous semiconductor located in a non-homogeneous magnetic field is calculated. It is shown that this e.m.f. is composed of two parts — bulk and boundary. Results are given of experiments carried out on indium antimonide by means of which the conclusions of the theory were varified. A.

537.311.33

4326. FABRICATION OF MULTIPLE JUNCTIONS IN SEMICONDUCTORS BY SURFACE MELT AND DIFFUSION IN THE SOLID STATE. K.Lehovec and A.Levitas.
J. appl. Phys., Vol. 28, No. 1, 106-9 (Jan., 1957).

Techniques are described for the preparation of multiple junction structures in semiconductors by solid-state diffusion of impurities from a region of a doubly doped crystal into an adjacent region of different impurity concentrations. The change in impurity concentrations from one region to the other is achieved initially by surface melting and regrowth, and is later modified by diffusion. Conditions which must be imposed on the doping levels, segregation coefficients, and diffusion constants of the doping materials employed are discussed. P-n-p, n-p-n, and n-p-n-p structures have been fabricated in germanium. A.

537.311.33

4327. CARRIER LIFETIME IN SEMICONDUCTORS FOR TRANSIENT CONDITIONS. D.J.Sandiford.
Phys. Rev., Vol. 105, No. 2, 524 (Jan. 15, 1957).

On the basis of the trap model, previously used in the analysis of steady-state recombination, the solution is given for the transient recombination of holes and electrons in semiconductors such as is encountered in photoconductive decay experiments. The solution contains two time-constants: τ_i, that associated with the readjustment in concentration of the recombination centres, and τ_t, the main recombination term. For low concentrations of recombination centres, τ_t and the Shockley—Read expression for steady-state lifetime are equivalent. A.

537.311.33

4328. HALL AND DRIFT MOBILITIES; THEIR RATIO AND TEMPERATURE DEPENDENCE IN SEMICONDUCTORS. F.J.Blatt.
Phys. Rev., Vol. 105, No. 4, 1203-5 (Feb. 15, 1957).

It is shown that the Hall and drift mobilities in the temperature range in which scattering by ionized impurities dominates should exhibit a temperature dependence less rapid than $T^{3/2}$. This conclusion is in agreement with experimental observation. Furthermore, the mobility ration, μ_H/μ_d, is not equal to $315\pi/512$ nor is it independent of temperature. Instead, μ_H/μ_d only approaches $315\pi/512$ at very high temperatures and decreases monotonically to $3\pi/8$ as the temperature is lowered. A.

537.311.33

4329. POSSIBLE MECHANISM FOR RADIATIONLESS RECOMBINATION IN SEMICONDUCTORS. L.Bess.
Phys. Rev., Vol. 105, No. 5, 1469-75 (March 1, 1957).

A set of two Auger-type processes has been found by which the trapping of a hole or electron can occur with the emission of an energetic hole or electron instead of a photon. A rough calculation is made of the cross-section of the combination of the two processes as well as the cross-section of the radiative process. For a wide class of semiconductors, it is found that the combination of the radiationless processes will predominate over the radiative one under practically all operating conditions. A.

537.311.33

4330. A CONTRIBUTION TO THE RECOMBINATION STATISTICS OF EXCESS CARRIERS IN SEMICONDUCTORS. P.T.Landsberg.
Proc. Phys. Soc. B, Vol. 70, Pt 3, 282-96 (March, 1957).

The formalism of recombination statistics is extended in various directions. In the case of inter-band transitions, the conditions under which a recombination coefficient exists are investigated, and the effect of degeneracy of electron and hole gas is discussed. In the case of transitions in which traps participate, the formalism is extended to cover (a) degeneracy and (b) the case when impurity centres have several trapping levels. The more important special cases of the general formalism are considered. In all cases the possibility has been borne in mind that the departure from equilibrium may not be small. A.

537.311.33

4331. MEASUREMENT OF SHORT CARRIER LIFETIMES. G.K.Wertheim and W.M.Augustyniak.
Rev. sci. Instrum., Vol. 27, No. 12, 1062-4 (Dec., 1956).

Semiconductor carrier lifetimes as short as 10^{-8} sec may be obtained from the decay of bombardment conductivity following pulsed excitation by high energy (700 keV) electrons from a Van de Graaff

accelerator. Bombardment damage of the sample is minimized by the use of short pulses (2×10^{-8} or 3×10^{-4} sec) and a low repetition rate (15 or 30 pulses per sec). Modification of a standard accelerator for these measurements is discussed in some detail and some typical results are presented. A.

537.311.33 : 535.37

4332. INAPPLICABILITY OF THE FERMI–DIRAC STATISTICS TO IMPURITY-CENTRE ELECTRONS IN SEMICONDUCTORS AND CRYSTAL PHOSPHORS. S.I.Pekar.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 351-3 (1956). In Russian.

The approach to statistical equilibrium between free and trapped electrons in semiconductors is rarely close enough for the two groups of electrons to be treated as the same quantum-statistical system. Consequently the Fermi–Dirac statistics are not strictly applicable to the trapped electrons. An ad hoc distribution is suggested which goes over to the Fermi–Dirac form when the mean energy-depth of the traps becomes vanishingly small.

J.W.Gardner

537.311.33

4333. MEASUREMENT OF SURFACE RECOMBINATION VELOCITY IN A THIN SEMICONDUCTOR SAMPLE WITH QUALITATIVELY DIFFERENT FACES. O.V.Sorokin.
Zh. tekh. Fiz., Vol. 26, No. 11, 2467-72 (1956). In Russian.

Continuity equations for holes and electrons are solved to give formulae connecting the effective diffusion length, L_α, of added carriers of current with the rates of surface recombinations s_1 and s_2 for the top and bottom faces respectively. The derived relationships permit relatively simply to calculate s_1 and s_2 from measurements of L_α. Z.Krasucki

537.311.33 : 535.343

4334. ELECTRICAL AND OPTICAL PROPERTIES OF TYPE IIb DIAMONDS. P.T.Wedepohl.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 177-85 (Feb., 1957).

The d.c. Hall coefficient and resistivity of six semiconducting diamonds have been measured as a function of temperature from 200 to 800°K. All the diamonds were p-type semiconductors. From the measurements the effective mass of the charge carriers, the concentration of donor and acceptor centres, the activation energy of the acceptors (close to 0.34 eV) and the temperature dependence of the Hall mobility have been calculated. At high temperatures the mobility varies as $T^{-2.8}$. The relative strengths of certain peaks in the infrared absorption spectrum are the same in different specimens. It is concluded that all these peaks are due to the same centre. These peaks are not detected in type I and type IIa diamonds. There is a strong correlation between the strength of the strongest peak at 0.346 eV and the number of vacant acceptor levels at room temperature, from which it is concluded that the centre giving rise to the peaks is also responsible for conduction. A.

537.311.33 : 539.11

4335. POSSIBLE INTERPRETATION OF CYCLOTRON RESONANCE ABSORPTION IN GRAPHITE. B.Lax and H.J.Zeiger.
Phys. Rev., Vol. 105, No. 5, 1466-8 (March 1, 1957).

An interpretation of cyclotron absorption experiments in graphite is presented. Evidence is given for the existence of a majority and minority hole, and a majority and minority electron. The masses for the majority hole and electron are $\sim 0.07\ m_0$ and $\sim 0.05\ m_0$, respectively. The masses for the minority hole and electron are $0.028\ m_0$ and $0.015\ m_0$, respectively. Strong indications of second and third harmonic cyclotron resonances for the minority carriers, and weaker indications of harmonics for the majority carriers are noted. Based on the assumption that these lines are correctly interpreted as harmonics, selection rules for harmonics of the cyclotron resonance exclude certain positions of the band extrema in the Brillouin zone. A.

537.311.33

4336. RADIATION DAMAGE EXPERIMENTS IN III-V-COMPOUNDS. U.Gonser and B.Okkerse.
Phys. Rev., Vol. 105, No. 2, 757-9 (Jan. 15, 1957).

Specimens of GaSb and InSb at low temperatures were bombarded with 2×10^{17} cm^{-2} of 12 MeV deuterons. The resistivity, temperature, and X-ray reflection spectra could be monitored before, during and after the irradiation. It is believed that the resultant effects are due to localized regions in the crystals with a quasi-liquid structure, but that on warming up to room temperature the effects disappear. C.A Hogarth

537.311.33

4337. INFRARED EMISSION OF GERMANIUM. P.Aigrain and C.Benoit à la Guillaume.
J. Phys. Radium, Vol. 17, No. 8-9, 709-11 (Aug.-Sept., 1956). In French.

By properly shaping a crystal of germanium (a Weierstrass sphere is used in the present work) it is possible to observe with high efficiency both the direct recombination of hole electrons pairs round an injecting contact ($\lambda \sim 1.8\ \mu$), and a far-infrared emission, which is thought to be a consequence of interband transition of accelerated holes. A.

537.311.33

4338. DENSITY OF STATES FOR WARPED SPHERICAL ENERGY SURFACES: ZEROTH ORDER SOLUTION FOR HOLES IN SILICON AND GERMANIUM. L.Gold.
J. Electronics, Vol. 2, No. 4, 323-9 (Jan., 1957).

The formalism for exact summing of states is applied to the problem of warped spherical energy surfaces and found essentially intractable (in so far as non-machine methods of computation) even when linearization is attempted. A zeroth order calculation is possible, however, which always establishes the lower bound of the density of states mass and in the limit of small warping approaches reasonable accuracy as is demonstrated for holes in germanium and silicon. A.

537.311.33 : 537.312.5

4339. FIELD EFFECT ON AN ILLUMINATED Ge SURFACE AND INVESTIGATION OF THE SURFACE RECOMBINATION PROCESS. S.Wang and G.Wallis.
Phys. Rev., Vol. 105, No. 5, 1459-64 (March 1, 1957).

Surface conductance, photoconductance, and field effect were measured in the Brattain–Bardeen ambient cycle on germanium surfaces etched with CP-4. From the surface-conductance measurement, values of surface potential were deduced, and from the photoconductance measurement, relative changes of surface recombination velocity were obtained. By analysing the change of surface recombination velocity as a function of surface potential, dominant recombination centres with discrete levels were found near the centre of the gap with a ratio of hole to electron capture probabilities of 9. The energy levels of these centres were found to be consistent with the field-effect data. In addition, the effect of a normal a.c. field upon an illuminated sample was examined. The results can be interpreted as a superposition of the changes in the photoconductance and the surface conductance due to the field-induced change in surface potential. This effect can be used to determine the value of trap energy and the ratio of capture probabilities to a greater degree of accuracy than can the surface recombination velocity. Possible other applications of the effect are discussed. A.

537.311.33

4340. INVESTIGATIONS OF SURFACE CONDUCTIVITY AND SURFACE RECOMBINATION IN SPECIMENS OF GERMANIUM. A.V.Rzhanov, I.G.Neizvestnyĭ and V.V.Roslyakov.
Zh. tekh. Fiz., Vol. 26, No. 10, 2142-53 (1956). In Russian.

The surface conductivity and surface recombination velocity of a number of specimens of Ge covering a range of resistivities, both p-type and n-type, were measured as a function of gaseous ambient during a Bardeen–Brattain cycle of dry O_2, wet O_2 and O_3. A correlation is established which is shown to be related to changes in the surface potential, the magnitude of which is estimated from the conductivity and type of conduction. The surfaces were etched in boiling concentrated H_2O_2 or in CP4, the former proving the more rewarding. The experimental results for the change in surface recombination velocity support the Shockley–Read model.

J.B.Arthur

537.311.33

4341. THE PROBLEM OF THE EFFECTIVE MASS OF ELECTRONS AND HOLES IN GERMANIUM. Z.Kopets.
Zh. tekh. Fiz., Vol. 26, No. 11, 2451-8 (1956). In Russian.

Means of determining effective mass from measurements of Hall effect and thermoelectric power (α) are discussed. A method is derived, valid only for specimens for which α increases with temperature, and is applied to data for polycrystalline Ge to give, at ~ 125°K, $m_e \sim 0.5$, $m_h \sim 0.25$. Comparison is made with cyclotron resonance data. C.H.L.Goodman

537.311.33

4342. RECOMBINATION RADIATION IN INDIUM ANTIMONIDE. T.S.Moss and T.H.Hawkins.
J. Phys. Radium, Vol. 17, No. 8-9, 712 (Aug.-Sept., 1956). In French.

537.311.33

4343. ELASTORESISTANCE CONSTANTS OF P-TYPE InSb AT 77°K. A.J.Tuzzolino.
Phys. Rev., Vol. 105, No. 4, 1411 (Feb. 15, 1957).

Samples of single crystal InSb, with 3×10^{15} holes/cm^3 at 77°K, were subjected to a tensile stress of 10^7 dynes/cm^2, and hydrostatic

pressure of 150 atm. The piezo- and elasto-resistance constants are calculated from the resulting change in resistivity. The likely position of extrema in the energy-band diagram is deduced.

C.Hilsum

537.311.33 : 538.632

4344. THE DEPENDENCE OF THE HALL COEFFICIENT OF A MIXED SEMICONDUCTOR UPON MAGNETIC INDUCTION AS EXEMPLIFIED BY INDIUM ANTIMONIDE. D.J.Howarth, R.H.Jones and E.H.Putley.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 124-35 (Jan., 1957).

The Bloch—Wilson theory for the Hall effect of a mixed conductor in an arbitrary magnetic field is discussed. A method of computation based upon the use of an electronic computer for fitting the theoretical expression to experimental data is described. To test the theory the method was applied to InSb. Good agreement was obtained between the observed behaviour of two p-type single crystals and the theoretical expression. The fitting of the theory to the experimental results enables the concentration of holes and electrons and their mobilities to be determined over a range of temperature. This leads to values of the intrinsic carrier concentration which are in good agreement with those found by other workers. It is also shown that in these specimens the mobility ratio falls as the temperature is reduced and that this behaviour can be expected from the effects of lattice and impurity scattering on the holes and electrons. A.

537.311.33

4345. THE INFLUENCE OF IMPURITIES ON THE ELECTRICAL PROPERTIES OF LEAD TELLURIDE. T.L.Koval'chik and Yu.P.Maslakovets.
Zh. tekh. Fiz., Vol. 26, No. 11, 2417-31 (1956). In Russian.

Carrier concentrations were obtained (from conductivity and thermoelectric data) as a function of excess of Pb or Te either alone or together with a particular impurity. Donors (e.g. Bi, Br) were only effective in producing carriers in the presence of excess Pb (or a similar element such as Sn or Ge). Excess Pb alone had no significant effect. An interpretation in terms of the formation of Pb defects in the presence of a donor appeared confirmed by unusually low carrier mobilities found in PbTe specimens doped with Bi and Br to which excess Pb was not added. Similar effects were found for acceptors in combination with excess Te. The behaviour of some 18 different elements in PbTe was studied. C.H.L.Goodman

537.311.33

4346. ELECTRICAL AND OPTICAL PROPERTIES OF SOME SEMICONDUCTORS: ZINC OXIDE, ZINC SULPHIDE, SELENIUM. R.Freymann, Y.Balcou, M.L.Blanchard, H.Corneteau, M.Freymann, B.Hagène, M.Hagène, M.Lepage, J.Meinnel and R.Rohmer.
J. Phys. Radium, Vol. 17, No. 8-9, 806-12 (Aug.-Sept., 1956). In French.

I. Optical, photodielectrical and electrical summarized properties of the various types of ZnO. II. Study of the dipolar Debye absorption of several samples of ZnO in terms of frequency and temperature. The activation energies found by that method and by conductivity and thermoluminescence methods are in good agreement. III. Two types of photodielectric effect are proposed: photoconductivity (free carriers) and photodipolar effect (bound carriers). Impure selenium shows the second one, but the activation energy decreases under irradiation. ZnS(Cu) shows absorption bands only under irradiation. For ZnO, the phenomena are intricate. A.

537.311.33

4347. CARRIER CONCENTRATION CHANGES IN p-Si INDUCED BY HEAT TREATMENT. Y.Matukura.
J. Phys. Soc. Japan, Vol. 12, No. 1, 103-4 (Jan., 1957).

Hall constant and resistivity measurements were made on samples from a p-type single crystal of Si which had been subjected to various heat treatments in the temperature range 400-1000°C. Differing effects with different gas ambients were found for heat treatment at 500°C. When samples, made more p-type by heating to 700°, were re-heated to 500°C, they reverted to n-type. This cycle was found to be repeatable. D.G.Avery

537.311.33

4348. PROPERTIES OF GOLD-DOPED SILICON. C.B.Collins, R.O.Carlson and C.J.Gallagher.
Phys. Rev., Vol. 105, No. 4, 1168-73 (Feb. 15, 1957).

Measurements of the temperature dependence of resistivity and Hall coefficient in gold-doped silicon show an acceptor level at 0.54 eV from the conduction band and a donor level at 0.35 eV from the valence band. These levels appear in equal concentrations within experimental error. The location of these levels is supported by photoconductivity measurements. A search was made for other levels associated with gold centres but none were found. The distribution coefficient for gold in silicon is 2.5×10^{-5}. Gold was introduced into the crystals by growing from a gold-doped melt and by diffusion into single crystals at high temperatures. The concentrations of gold observed in solution after saturation at various temperatures is consistent with that expected from the distribution coefficient. Gold acts as a recombination centre detectable at concentrations as low as 10^{12} per cm^3. Because the acceptor level is so close to the centre of the forbidden band, it is possible to shift the Fermi level below the middle with large ratios of gold to residual donors. The acceptor level is measured in p-type silicon as 0.62 eV from the valence band, giving a value of band gap consistent with previous measurements by other methods. A.

537.311.33

4349. IONIZATION RATES FOR HOLES AND ELECTRONS IN SILICON. S.L.Miller.
Phys. Rev., Vol. 105, No. 4, 1246-9 (Feb. 15, 1957).

The rates at high electric fields have been evaluated from data on the multiplication of reverse-biased junctions. In Si, electrons have a higher ionization rate than holes. The variation of ionization rate with field strength is in good agreement with theory. A.

537.311.33 : 537.533.9

4350. ENERGY LEVELS IN ELECTRON-BOMBARDED SILICON. G.K.Wertheim.
Phys. Rev., Vol. 105, No. 6, 1730-5 (March 15, 1957).

Electron bombardment of n- and p-type silicon reduces the lifetime of minority carriers and decreases the carrier concentration. This paper presents evidence that: (a) an electron trapping level is located 0.16 eV below the conduction band and a hole-trapping level 0.29 eV above the valence band, (b) the recombination centres responsible for the reduction of lifetime in n-type are located 0.31 eV from a band-edge, and those in p-type approximately 0.24 eV from a band-edge, (c) lattice imperfections are produced at a rate of 0.18 per electron-cm of bombardment at 700 keV. A.

537.311.33 : 535.43

4351. ELECTRICAL AND OPTICAL PROPERTIES OF HEAT-TREATED SILICON. W.Kaiser.
Phys. Rev., Vol. 105, No. 6, 1751-6 (March 15, 1957).

Single crystals of silicon exhibit optical scattering between 1 and 3 μ after a heat treatment at 1000°C. The Tyndall effect was observed in such samples by using an infrared image tube. The number of donor states, produced in silicon during a 450°C heat treatment, increased rapidly with increasing oxygen concentration of the sample. These effects were found in silicon crystals which were pulled from quartz crucibles; they could not be detected in samples prepared by the floating-zone technique in vacuum. A.

537.311.33

4352. STUDY OF THE RECOMBINATION PROCESS IN TELLURIUM. A.P.de Carvalho.
C.R. Acad. Sci. (Paris), Vol. 244, No. 4, 461-2 (Jan. 21, 1957). In French.

Te is zone-refined until the impurity density is $\sim 10^{15}$ cm^{-3} and then recrystallized by slow cooling. From the photomagnetoelectric effect and its temperature variation, the minority carrier lifetime is obtained, being $\sim 10^{-8}$ sec at 290°K. The Auger effect can account for the observed recombination. C.A.Hogarth

537.311.33 : 535.8

TWO OPTICAL INSTRUMENTS USED IN SEMICONDUCTOR RESEARCH. See Abstr. 4259

537.311.33

4353. RECTIFYING SEMICONDUCTOR CONTACTS. H.K.Henisch. London: Oxford University Press (1957) 384 pp. (International Series of Monographs on Physics).

The introductory chapters deal with the basic relations governing electronic transport phenomena, with the band theory of solids, the nature of impurity centres and with equilibrium conditions of electrons and holes in semiconductors under various conditions. There is also a summary of the bulk properties of selected materials which have contact properties of interest. The historical development of rectifying devices is briefly reviewed, and a descriptive account of rectifying systems and their principal characteristics is given. Idealized models of metal—semiconductor interfaces are developed, with special reference to the effect of surface states. The theoretical consequences of these models in terms of voltage current relations, rectifier capacitance and photoelectric response are assessed for single-carrier and two-carrier rectification mechanisms. One chapter deals with more specialized contact effects, e.g. as arising from lateral heterogeneity and discontinuous barrier profiles, and also with thermal effects, forming phenomena and the

behaviour of rectifiers at high frequencies. There is an extensive discussion of measurements on injecting and non-injecting contacts (injection ratio, barrier height, barrier thickness, hole storage, self-oscillations, floating potentials, etc.) and a critical examination of the various models now available for the interpretation of the results. The experimental methods used in the investigation of contact properties are described in detail.

537.311.33 : 621.314.63

4354. RECTIFICATION PROPERTIES OF METAL–SILICON CONTACTS. E.C.Wurst, Jr and E.H.Borneman.
J. appl. Phys., Vol. 28, No. 2, 235-40 (Feb., 1957).

Area contacts of twenty different metals were made on n and p silicon. The contacts were applied by the use of jet plating techniques, with the exception of alkali metal contacts which were pressure contact or mercury amalgam contact. A qualitative correlation is shown to exist between the work function of the metals and the rectification of these metals on n and p silicon. Current–voltage characteristics taken on eleven of these metal–silicon contacts lend further support to this picture. Consideration of a quantitative work-function model is made difficult due to the many errors and interpretations involved in using metal work-function values. Transistor structures were made and studied for several of the metal–silicon contacts. From analysis of this transistor data it is found that an excess current three orders of magnitude greater than theory predicts, must be present in the diodes made from these metals. This excess current is not adequately explained by any presently known mechanism. A.

537.311.33 : 621.314.63

4355. THE ISOTHERMAL REVERSE VOLTAGE–CURRENT CHARACTERISTICS OF SMALL AREA ALLOY CONTACTS ON GERMANIUM. E.G.S.Paige.
J. Electronics, Vol. 2, No. 4, 378-86 (Jan., 1957).

The isothermal reverse voltage–current characteristics of small area pn and nn+ junctions on n-type germanium have been measured. At sufficiently high currents the characteristics become independent of the type of junction and similar in form to the reverse characteristic of a point contact. The results verify Gunn's theory for the resistance of a small area contact and yield a value of approximately 6×10^4 V cm^{-1} for the field in which avalanche multiplication takes place. The relationship of these results to observations on point contacts are discussed. A.

537.311.33

4356. RECOMBINATION RADIATION FROM DEFORMED AND ALLOYED GERMANIUM P-N JUNCTIONS AT 80°K. R.Newman.
Phys. Rev., Vol. 105, No. 6, 1715-20 (March 15, 1957).

The recombination radiation from germanium p-n junctions (T ~ 80°K) which have been plastically deformed shows two bands of radiation. One band, which peaks at 0.7 eV, is an intrinsic property. The second, which peaks at about 0.5 eV, appears to be characteristic of deformed material or material in which slip has occurred. A slight change in the position of the 0.5 eV peak occurs upon annealing. The band at 0.5 eV is also found in the radiation from alloyed p-n junctions. Junctions containing copper show a radiation band at 0.59 eV. A.

537.311.33 : 621.314.63

4357. SOME CHARACTERISTICS OF GERMANIUM DIODES WITH GOLD ADMIXTURE. A.A.Lebedev, V.I.Stafeev and V.M.Tuchkevich.
Zh. tekh. Fiz., Vol. 26, No. 10, 2131-41 (1956). In Russian.

At low temperatures the diode resistance is high, most of the voltage drop taking place in the main body of germanium and not in the transition layer. The impurity carriers increase the concentration of the basic carriers in the germanium, and reduce its resistance. A redistribution of the p.d. applied between the germanium and the transition layer ensues, which under certain conditions has an unsteady character and may lead to a sudden rise of the conductivity of the diode and a breakdown. An approximate analytical theory is presented. Electrical Research Association

537.311.33

4358. ON THE BREAKDOWN OF JUNCTION LAYERS IN SEMICONDUCTORS. B.M.Vul.
Zh. tekh. Fiz., Vol. 26, No. 11, 2403-16 (1956). In Russian.

A reverse-biased p–n junction in a semiconductor provides a useful means of studying the electrical breakdown mechanism. Breakdown is classified as either thermal or electrical and each form is treated separately. A simple analysis of thermal breakdown is given and later modified to take account of the effects of
(a) a shunt resistance which is invariant with temperature,
(b) an additional current which is independent of the voltage,
(c) additional losses not dependent on the reverse voltage (e.g. heating due to forward current when the junction is used as a rectifier), and (d) the thermal conductivity of the crystal. Electrical breakdown is then analysed on the assumption of the collision ionization theory and an expression for the multiplication coefficient is derived. Finally, the two forms of breakdown are combined.

J.B.Arthur

537.311.33 : 621.314.7

4359. TRANSISTORS. VOLUME I.
Princeton, N.J. : R.C.A. Laboratories (1956) 676 pp.

For abstracts of some of the papers see Abstr. 1281-2, 2216, 2241 (1957).

537.311.33 : 621.314.7

4360. EMITTER CURRENT NOISE IN JUNCTION TRANSISTOR. T.Yajima.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1126-7 (Oct., 1956).

Studies on n–p–n grown junction tetrodes suggest that the 1/f noise includes a partition-noise component and may in part arise from carrier recombination processes in the base region and at the nearby surface. C.A.Hogarth

537.311.33

4361. POINT CONTACT TRANSISTOR STUDIES USING RADIOACTIVE COLLECTORS. D.Haneman and A.J.Mortlock.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 145-7 (Jan., 1957).

The number of atoms transferred to a germanium base whilst forming an antimony collector to produce enhanced current gain has been measured. The values range from 2×10^{11} to 6×10^{14}. The diameter of the formed surface area was determined by autoradiography. From calculations of diffusion rates it is concluded that phase boundaries must form in the affected region. These may play a part in producing current gain. K.W.Plessner

537.311.33

4362. TRANSISTOR ACTION ON NATURAL GALENA SURFACE AFTER HEAT TREATMENT WITH H_2S. J.N.Das and P.V.Khandekar.
Z. Phys., Vol. 147, No. 3, 271-6 (1957).

The n-type diode characteristics of natural galena change over to p-type after heat treatment in H_2S. These galena surfaces treated with H_2S were found to show transistor action and photovoltaic effects also. A study of the cleaved surfaces of such galena crystals after heat treatment in H_2S revealed that the spreading resistance R_S increases up to a certain depth, below the outer surface indicating the existence of a high resistivity layer. On removing surface layers by carefully scraping with sand paper (a) the rectifying characteristics improved, and (b) photovoltaic effects could be observed. Under these conditions transistor action with current gain = 0.83 and voltage gain of about 4 could be obtained. A.

537.311.4 : 621.316.5.064.2

4363. THE FORMATION AND RUPTURE OF MOLTEN METAL BRIDGES IN ELECTRICAL CONTACTS. F.Llewellyn Jones and R.H.Jones.
Z. phys., Vol. 147, No. 1, 43-58 (1957).

The theory of the formation, development and rupture of contact bridges is discussed, and an experimental study of the properties of bridges between slowly opening contacts is described. Observations have been made on bridges in the ordinary atmosphere and in vacuo. The method of producing bridges for visual examination in air and in vacuo has been applied to an investigation of bridges of the noble metals, and of the readily oxidizable base metals. The temperature in a bridge can reach very high values, approaching the boiling point of the metal, with a potential difference of only one to two volts between the electrodes. Theoretical predictions of the shape of molten metal bridges as controlled by the temperature distribution and by surface tension and electrodynamic forces are compared with the shapes actually observed. Photographs of bridges showing the agreement between theory and experiment are given. The potential difference between the electrodes when the rupture of the bridge takes place, – the rupture voltage, has been measured for a number of metals: Pt, Pd, Ag, Au, Cu, Fe, Ni, W, Mo and Sn. The results are discussed in relation to theories of the cause and the mode of rupture and to the electrical and thermal properties of metals at high temperatures. A.

537.312.5 : 537.311.33

4364. ELECTRICAL CONDUCTION AND PHOTOCONDUCTIVITY OF PHTHALOCYANINES. A.T.Vartanyan and I.A.Karpovich.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 3, 561-3 (1956). In Russian.

Evaporated layers of phthalocyanine (Ph), and of Cu–Ph, Zn–Ph, and Mg–Ph were studied. For very pure materials electrical conductivity (σ) ~ 10^{-12} - 10^{-13} ohm^{-1}cm^{-1} and its thermal activation energy (E) ~ 1.7 – 1.8 eV, except for Mg–Ph which could not be entirely freed of oxygen (σ ~ 10^{-9} ohm^{-1} cm^{-1}, E ~

1.2 eV). Photocurrents were small and of rapid response. Heating in O_2 (a) increased σ for metal–Ph compounds by $> 10^4$, but by relatively little for Ph, (b) reduced E sharply for metal–Ph compounds but increased it slightly for Ph, (c) increased photocurrents, though light/dark-current ratio fell off and response time became large. Energy gaps from the half-response for the long-wave photocurrents cut-off were: Ph = 1.65, Cu–Ph = 1.64, Zn–Ph = 1.61, Mg–Ph = 1.51 eV. C.H.L.Goodman

537.312.5

4365. IMPEDANCE MEASUREMENTS ON CdS CRYSTALS. B.Kramer, S.Jaffe and H.Kallmann.
J. Phys. Radium, Vol. 17, No. 8-9, 790 (Aug.-Sept., 1956). In French.

537.312.5

4366. THEORETICAL INTERPRETATION OF THE HAMAKER–BEEZHOLD BALLISTIC EFFECT IN BLOCKING LAYER PHOTOCELLS. G.Blet.
J. Phys. Radium, Vol. 18, No. 1, 5-8 (Jan., 1957). In French.

This phenomenon can be accounted for qualitatively by means of the theory previously propounded by the author. A check of the validity of the hypothesis is obtained and the field, where it is valid, is extended. A.

537.312.5

4367. PHOTOCONDUCTIVITY IN LEAD SELENIDE: THEORY OF THE DEPENDENCE OF SENSITIVITY ON FILM THICKNESS AND ABSORPTION COEFFICIENTS. J.N.Humphrey and R.L.Petritz.
Phys. Rev., Vol. 105, No. 4, 1192-7 (Feb. 15, 1957).

Recently developed theoretical expressions for the responsivity R_S and noise of photoconductive films are examined. Assuming that the time constant is independent of film thickness R_S and signal/noise (S/N) are expressed in terms of the absorption coefficient α and thickness d. Using a curve of α v. λ for lead selenide obtained by Avery from crystal measurements, R_S v. λ is calculated for films of different thicknesses. These curves indicate that the photoconductive knee should lie near 5 μ for PbSe films of all thicknesses. Experimentally, however, the position of the knee is observed to be a function of film thickness, being near 3.3 μ in thin films and 5 μ in thick films. It is then shown from the theory that in very thin films the responsivity is a direct measure of α. Accordingly the wavelength dependence of α is calculated from responsivity data for thin films; the magnitude is determined from the crystal absorption data at 5 μ. Curves of responsivity v. λ for various film thicknesses are computed, using the α v. λ curve derived from responsivity data on thin films. These curves agree with the observed responsivity data; they show the shift of the knee from 3.3 to 5 μ with increased film thickness, and show that no increase in responsivity can be obtained at any wavelength by increasing the film thickness. The dependence of signal/noise on λ and d is calculated, using the same α v. λ curve, and found to be in qualitative agreement with experiment. The curves show that for any given wavelength the signal/noise is a maximum at a certain value of film thickness. The maximum occurs at greater thicknesses for longer wavelengths. The dependence of S/N on d and α is given for any material fitting the same general photoconductive model. The same conclusion, that there is an optimum thickness for any particular absorption coefficient, holds in this general case. Finally, the derived α v. λ curve is shown to be consistent with recent theories of indirect optical transitions. A.

537.312.5 : 535.371

4368. DE-EXCITATION OF ZnS AND ZnCdS PHOSPHORS BY ELECTRIC FIELDS. H.Kallmann and P.Mark.
Phys. Rev., Vol. 105, No. 5, 1445-50 (March 1, 1957).

With the aid of a.c. impedance measurements, the influence of strong a.c. and d.c. fields applied during the decay of photoconductivity of ZnS and ZnCdS phosphors is described. Rise and decay curves of photoconductivity with and without field application are presented which demonstrate that electric fields accelerate the de-excitation process. A.C. fields are capable of removing all excited electrons from the pre-excited ZnS (LG) phosphor and d.c. fields show a similar but weaker effect. This de-excitation is attributed to the considerable reduction of retrapping of excited electrons when these phosphors decay under the action of electric fields. A.

537.312.5

4369. CdS-TYPE PHOTOCONDUCTIVITY IN ZnTe CRYSTALS. R.H.Bube and E.L.Lind.
Phys. Rev., Vol. 105, No. 6, 1711-12 (March 15, 1957).

An investigation of photoconductivity in single crystals of ZnTe has revealed that the mechanism proposed for photoconductivity phenomena in CdS and CdSe may also be applied to ZnTe. These phenomena include the variation of photocurrent with light intensity and temperature, and the infrared quenching of photoconductivity. A.

537.312.5

4370. PHOTOCONDUCTIVITY OF LEAD SELENIDE: THEORY OF THE MECHANISM OF SENSITIZATION. J.N.Humphrey and R.L.Petritz.
Phys. Rev., Vol. 105, No. 6, 1736-40 (March 15, 1957).

The intrinsic, majority, and minority carrier models of photoconductivity are critically examined in terms of an experimental study of the effect of oxygen, sulphur, selenium, and the halogens on PbSe films. It is concluded that the only model adequately describing these experimental results is the following: Radiation is absorbed in the crystallites and produces a main-band electron transition. Recombination centres which exist in the film produce a very short photoconductive time constant in a non-sesitized film; at room temperature this time constant is so small in PbSe that no photoconductivity is observed. Treatment with oxygen introduces minority carrier traps which increase the majority carrier lifetime and enhance the photoconductive sensitivity, both at room temperature and at reduced temperatures. Similar treatment with sulphur introduces shallow electron traps, which are effective in increasing the majority carrier lifetime at -195°C but not at room temperature. Selenium and the halogens do not introduce minority carrier traps effective at any temperature studied. A.

537.312.5

4371. SEMITRANSPARENT PHOTOCATHODES AT LOW TEMPERATURES. W.J.Harper and W.J.Choyke.
Rev. sci. Instrum., Vol. 27, No. 11, 966 (Nov., 1956).

Curves of the quantum yield produced by the rear illumination of photosurfaces of Sb, Bi and Te each with Cs and Rb (prepared on transparent electrically conducting films of tin oxide) are given for a range of wavelengths from 350 to 700 mμ and for temperatures of 25 and -175°C. J.Dutton

537.312.5 : 551.521.1

4372. PHOTOELECTRIC CONVERTERS OF SOLAR ENERGY MADE FROM P-TYPE SILICON. Yu.P.Maslakovets, S.A.Poltinnikov, G.B.Dubrovskiĭ and V.K.Subashiev.
Zh. tekh. Fiz., Vol. 26, No. 10, 2396-7 (1956). In Russian.

Vapour phase diffusion of Sb into p-type Si gave n–p junctions showing a photovoltaic peak response at 700 mμ. One such element, area 1 cm^2 had the following characteristics in direct sunlight: short circuit current 10 mA, open circuit voltage 450 mV, maximum conversion efficiency 2.8% with 300 mV generated across a 33 ohm load. C.H.L.Goodman

537.312.5 : 537.311.33

4373. THE SO-CALLED "SECONDARY" AND "THROUGH" PHOTOCURRENT IN SEMICONDUCTORS. S.M.Ryvkin.
Zh. tekh. Fiz., Vol. 26, No. 11, 2439-47 (1956). In Russian.

The use of terminology which includes notions of primary and secondary photocurrents in describing photoelectric phenomena in semiconductors is criticized. It is shown, that identification of the secondary with the "through" photocurrents is incorrect. A new terminology is proposed for description of the kinetics of photocurrent connected with establishment of the diffusion–drift and recombination equilibria in semiconductors. Z.Krasucki

537.312.5 : 621.383.27

4374. THE LIMITING FACTOR AND INTRINSIC NOISE OF ELECTRON-OPTICAL PHOTOMULTIPLIERS. E.K.Zavoĭskiĭ, M.M.But-slov and G.E.Smolkin.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 5, 996-9 (1956). In Russian.

Although the coefficient of multiplication can be made as great as desired, its practical maximum value is that (η_{lim}) at which a single electron can be recorded; it is estimated that $\eta_{lim} \cong 10^5$. When using the (Soviet) type 95 photomultiplier, it was found that the noise produced by the dark-emission electrons of the input photocathode consisted of separate flashes similar to scintillations, the flash area being $\cong 10^{-4}$ cm^2. Most flashes were found to be due not to single electrons but to packets of electrons. The isolation and recording of a single electron and the explanation of the nature of the multi-electron component were achieved by blurring the electron image in the input cascade of the photomultiplier. It was found that, for the cascade potential difference ΔU = 12 kV, the Sb–Cs photocathode emitted ~ 20 cm^{-2} sec^{-1} single electrons and ~ 500 cm^{-2} sec^{-1} electron packets at room temperature, the number of electrons in a packet varying from 2 to 20 (modal value between 7 and 12). The single-electron current disappeared when the photocathode was cooled in liquid N, the multi-electron component remaining nearly unchanged at this temperature. The number of electron groups (N) varies with ΔU roughly according to the relationship N cm^{-2} sec^{-1} ~ a$(\Delta U)^5$. F.Lachman

537.312.5 : 621.383.27

4375. OPTICAL FEEDBACK IN PHOTOMULTIPLIERS. R.Gerharz.
J. Electronics, Vol. 2, No. 5, 409-15 (March, 1957).

Dark-current-induced electrofluorescence in commercially available 1P21 and 931A photomultipliers and its optical feedback to the photocathode were investigated visually and electronically. Methods of demonstrating the feedback effects include a photomultiplier as a detector looking into the tube under test and the increase in dark current counts after placing a reflective cylinder over the glass envelope of the tube. A diagram, showing the luminescence v. operating voltage for a noisy tube is presented. A.

537.312.5 : 535.373

FORMAL ANALYSIS OF THE THEORY OF TWO-STAGE EXCITATION OF PHOSPHORESCENCE AND PHOTOCONDUCTIVITY. See Abstr. 4221

537.312.62

4376. ISOTOPE EFFECT IN SUPERCONDUCTING LEAD. R.R.Hake, D.E.Mapother and D.L.Decker.
Phys. Rev., Vol. 104, No. 2, 549-50 (Oct. 15, 1956).

This was measured on six samples ranging in mean atomic weight M from 206.19 to 207.81. For five of these $T_c \propto M^{-0.5}$, in accordance with theory and with the behaviour of other superconductors, whereas former measurements on lead had given $T \propto M^{-0.73}$. The sixth sample (M = 206.19) deviates. It also shows a less sharp magnetic transition. This behaviour persisted even after further purification and recrystallization. The only respect in which this specimen appears to differ markedly from the others is that it has a relatively broad isotopic mass distribution. H.London

537.312.62

4377. ENERGY GAP INTERPRETATION OF EXPERIMENTS ON INFRARED TRANSMISSION THROUGH SUPERCONDUCTING FILMS. M.Tinkham.
Phys. Rev., Vol. 104, No. 3, 845-6 (Nov. 1, 1956).

The observed peak in transmission at intermediate frequencies (Abstr. 2443/1957) is interpreted in terms of a simple energy-gap model of a superconductor. E.H.Sondheimer

537.312.62

4378. NUCLEAR MAGNETIC RESONANCE IN A SUPERCONDUCTOR. W.D.Knight, G.M.Androes and R.H.Hammond.
Phys. Rev., Vol. 104, No. 3, 852-3 (Nov. 1, 1956).

A shift of the resonance by ~ 0.5% was observed in colloidal Hg at temperatures $< 2^\circ$K and d.c. fields $\leq$ 5200 Oe. The particles used (mainly < 200 A dia.) are smaller than the penetration depth of the magnetic field and they can be expected to be superconducting under the above conditions. H.London

537.312.62

4379. SUPERCONDUCTIVITY OF MICROSCOPIC TIN FILAMENTS. O.S.Lutes.
Phys. Rev., Vol. 105, No. 5, 1451-8 (March 1, 1957).

An experimental determination has been made of the magnetic fields necessary to induce the superconducting transition in microscopic tin filaments called "whiskers". For temperatures near the zero-field transition temperature, T_c, the results are unambiguous, and in this region the critical fields are significantly higher than those of a bulk superconductor. At lower temperatures the critical field curve splits into two parts, the upper curve giving the field for destruction of superconductivity and the lower curve the field for restoration. The temperature dependence of the critical field is compared with the predictions of the London and Ginsburg–Landau theories of superconductivity. It is found that the London theory is inadequate to describe the data over the whole useful range, whereas the Ginsburg–Landau theory provides a satisfactory fit. The disappearance of hysteresis occurs at a temperature for which $2.0 \leq h_c/H_c \leq 2.4$, where h_c/H_c is the ratio of whisker to bulk critical fields. This is in reasonable agreement with the Ginsburg–Landau–Silin condition for the onset of second order transitions. An effective value of λ_0, the penetration depth at 0°K, is derived from the data for each whisker. λ_0 shows a strong dependence on the normal electrical conductivity, as estimated from the change in resistance at the transition. At long mean free path the results are in agreement with those obtained from bulk specimen measurements, but at short mean free path the present λ_0 values are higher. A.

537.312.8

4380. EFFECT OF A MAGNETIC FIELD ON THE ELECTRICAL RESISTANCE OF THIN FILMS OF NICKEL. T.Rappeneau.
C.R. Acad. Sci. (Paris), Vol. 243, No. 19, 1403-6 (Nov. 5, 1956). In French.

Reports results of room temperature measurements on evaporated nickel films at fields up to 6000 oersted. If the magnetization is perpendicular to the current the resistance decreases in the field, and if it is parallel the resistance increases, hysteresis being observed in low fields. In high fields there is a slight decrease of resistance in both cases. E.P.Wohlfarth

537.312.8

4381. MAGNETO-RESISTANCE IN METALS. D.K.C.MacDonald.
Phil. Mag. (Eighth Ser.), Vol. 2, 97-112 (Jan., 1957).

Experiments are reported in which novel results are found on the magnetoresistance of sodium and rubidium. Measurements have been made both on plate-like specimens which show very strong anisotropy in the magnetic field, and on a cylinder of diameter large compared with the mean free path, l, of the electrons. The anomalous behaviour appears certainly to depend on the attainment of large values of the ratio l/r, where r is the orbital radius of a free electron in the magnetic field. A.

537.312.9

4382. DEPENDENCE OF ELECTRICAL CONDUCTIVITY OF POLYCRYSTALLINE SELENIUM ON PRESSURE UP TO 30 000 ATM. P.T.Kozyrev and D.N.Nasledov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 2, 207-8 (1956). In Russian.

Investigations were made with specially purified polycrystalline selenium at temperatures in the range from 20°C to 125°C. At high pressures electrical conductivity, σ, increases exponentially with pressure. Activation energy, E, decreases with increasing pressure. At high pressures, the value of σ of chemically pure but not purified selenium almost coincides with that for purified selenium. Z.Krasucki

537.312.9 : 548.7

4383. THE EFFECT OF PRIOR EXTENSION ON THE ANNEALING RATE OF LATTICE VACANCIES IN PLATINUM. S.Pearson and F.J.Bradshaw.
Phil. Mag. (Eighth Ser.), Vol. 1, 880-2 (Sept., 1956).

It has been shown previously that platinum wires quenched from a high temperature show an increase in electrical resistance (ΔR) which anneals out on re-heating the wires to intermediate temperatures (Abstr. 2821/1957). This note reports an increase in the rate of annealing of ΔR on stretching the wires (<10%) after quenching. The annealing rate (at one standard temperature ~ 400°C) increases rapidly for small extensions, but at greater than ½% extension the increase is linear: by 9% the rate is about 30 times greater than for unstretched wires. These changes in resistance are believed to be due to lattice vacancies — frozen in on quenching — which migrate to dislocation sinks and disappear on annealing, the dislocation density being increased when the wires are stretched. A.B.Lidiard

537.323 : 537.311.31

4384. THE TEMPERATURE DEPENDENCE OF THE THERMAL E.M.F. OF GREY TIN ALLOYED WITH CADMIUM. P.R.Kamadžiev.
Czech. J. Phys., Vol. 6, No. 5, 453-7 (Oct., 1957). In Russian.

The thermal e.m.f. and electric conductivity as a function of the temperature in the range -183° to about 10°C was measured on samples of grey tin alloyed with cadmium. The specimens were prepared by alloying spectrally pure tin, which was then cooled in a closed container for a long period at -40° to -50°C so that during the β-Sn $\rightarrow \alpha$-Sn transition a compression accurred of the individual grains. By analysing the results it was found that the activation energy increases with increasing concentration of cadmium and that cadmium behaves as a p-type impurity since specimens sufficiently alloyed with cadmium have a positive sign at lower temperatures, which becomes negative on entering the region of intrinsic conductivity when the influence of the electrons predominates. A.

537.323

4385. THERMOELECTRIC BEHAVIOR OF SOLID PARTICULATE SYSTEMS. NICKEL OXIDE. G.Parravano and C.A.Domenicali.
J. chem. Phys., Vol. 26, No. 2, 359-66 (Feb., 1957).

Thermoelectric power measurements have been performed on powdered nickel oxide in the temperature range 60-220°C, under different gas atmospheres. These include: oxygen, hydrogen, carbon monoxide, carbon dioxide, nitrous oxide, helium, and water vapour, at different partial pressures. The extent and direction of the observed changes in thermoelectric power of the oxide following gas chemisorption have been related to the extent and nature of the electron transfer process taking place between the different gaseous molecules and the conducting surface. A theoretical analysis is presented. The analysis shows how the ratio between the thickness of the space charge layer at the surface and the "thickness" of the thermal gradient affects the thermoelectric power change resulting from chemisorption. Since this ratio depends on the size and size

distribution of the solid particles, this effect provides a further parameter which can be used to control and modify the electronic characteristics of semiconducting particulate systems. A.

537.323

4386. ON THE INFLUENCE OF THE AMBIENT ATMOSPHERE ON THE THERMOELECTRIC POWER OF A COUPLE OF SOLID SILVER/THIN SILVER FILM. H.Benel.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 21, No. 1, 26-33 (Jan., 1956). In French.

Systematic investigation from room temperature up to 300° C of couples where the thickness of the thin film is of order 20-200 mμ The thermoelectric power is strongly dependent on the pressure of ambient gas and passes through a maximum for a thickness of 30 mμ for the thin film. C.A.Hogarth

ELECTRIC DISCHARGES 537.52

537.521.7

4387. A SPECTROSCOPIC STUDY OF A CONDENSED AND UNCONDENSED SPARK BETWEEN COPPER ELECTRODES IN THREE DIFFERENT GASES AT VARIOUS PRESSURES. IV. POSSIBLE EXPLANATIONS OF OBSERVED SPECTRAL PECULIARITIES. J.Singh.
J. sci. Res. Banaras Hindu Univ., Vol. 6, No. 1, 32-7 (1955-56).

In previous communications (for Pt III, see Abstr. 6102/1951) a series of experiments was carried out on the effects of pressures in three different gases, namely air, CO_2 and the illuminating gas, regarding the developments of lines, bands and the continua. In the present paper an attempt has been made to explain the experimental observations. A.

537.523.3 : 621.3.015.532

4388. ELECTRICAL AND OPTICAL CHARACTERISTICS OF D.C. CORONA DISCHARGES IN AIR AT ATMOSPHERIC PRESSURE. B.Murphy.
Rep. Brit. Elect. Res. Assoc., Rep. L/T 329, 30 pp. (1956).

D.C. positive-point to plane corona discharges in untreated room air have been studied with the aid of a photo-multiplier, wide band (distributed) amplifiers and a high-speed c.r.o. The results indicated that a pulsed form of discharge did not necessarily occur. When a pulsed form did occur, the pulses were associated with streamers propagating from the positive point towards the negative plane. Direct evidence was obtained that some ionization and considerable excitation occurred ahead of and around the streamers. Streamers did not branch until after they began to decay. Branches did not propagate simultaneously. This accounted for the characteristic visual form of the self-maintained positive point corona discharge in air. All the results could be explained satisfactorily on the latest ideas of the streamer theory, when due consideration was given to increase in the excess positive space charge in a streamer as it began to die away and electrons were removed from the channel. The exact mechanism initiating a streamer is obscure, since streamers occurred readily at values of X/P at the point surface of 80 to 90 Vcm^{-1} mm. Hg., when "avalanches" only consisted of tens of electrons. Negative ion formation may play a predominant part in the streamer discharge in air. The electrical pulses associated with streamers were shown to depend largely on the gap geometry and the external circuit. A.

537.523.4

4389. AN IMPORTANT CHARACTERISTIC OF LONG ELECTRICAL DISCHARGES. C.E.R.Bruce.
Appl. sci. Res. B, Vol. 5, No. 1-4, 285-8 (1955).

Breakdown to a thermally ionized column is completed during the leader stroke of lightning and long sparks. The leader acts as a partial short circuit of the pre-discharge field and transfers the initial field concentration to other regions. Cosmical effects and star spectra are related phenomena. C.G.Morgan

537.523.4 : 621.3.015.5

4390. THE LIMITS OF THE STREAMER MECHANISM IN THE ELECTRICAL BREAKDOWN IN AIR. W.Köhrmann.
Appl. sci. Res. B, Vol. 5, No. 1-4, 288-90 (1955).

Measurement of breakdown voltage in air between plane electrodes in the range $500 < pd < 1500$ (mm Hg) (cm) gave lower values than obtained by previous workers. This appears to indicate that the so-called streamer mechanism does not occur at the threshold voltage but only at overvoltages. Formative time-lag measurements seem to show that a streamer does not occur for < 5% overvoltage when the discharge commences by the Townsend mechanism. The streamer appears to be connected with the sudden collapse to zero of the gap voltage. C.G.Morgan

537.523.4 : 621.3.015.54

4391. LONG SPARKS FROM NEGATIVE ELECTRODE WITH LIMITED CURRENT IN AIR AT ATMOSPHERIC PRESSURE. H.Norinder and O.Salka.
Ark. Fys., Vol. 10, Paper 30, 397-423 (1956).

Extension of previous work (Abstr. 9505/1951; 3328/1953; 1347/1954) to the photographic and oscillographic (current and voltage) investigation of the breakdown of point-to-plane and sphere-to-plane gaps of lengths from 5 to 52 cm. Complete breakdown is considered as occurring in three stages (pre-discharge, spark and arc), and the discharges are classified into two groups depending on whether or not the spark follows the path of the pre-discharge. The groups were found to contain seven types of discharge, the type being dependent on the shape and capacity of the electrodes, the interelectrode gap and the energy instantaneously available for the spark. J.Dutton

537.523.4

4392. RETURN DISCHARGE IN LONG SPARKS. V.S.Komel'kov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 3, 589-92 (1956). In Russian.

The technique for photographing discharges and the circuit for obtaining a voltage pulse were the same as reported earlier (Komel'kov, Izv. Akad Nauk SSSR, Otdel tekh. Nauk. No. 8, 955, 1947). Tensions of 500 kV with point to plane discharges in gaps of 80-85 cm were employed and a useful table of data concerned with these discharges is provided. Among other things the results of the experiment show that for the appearance of a return discharge in long sparks it is not essential to have short-circuiting of the electrodes by the conducting channel as suggested earlier. A return discharge arises in all cases when there is sufficient change of potential of the electrodes (or of the plasma) of the leader channel (or other zone of plasma). C.R.S.Manders

537.523.4 : 621.9.018.5

4393. THE EFFECT OF HEAT CONDUCTION ON ELECTRICAL EROSION OF METALS. A.S.Zingerman.
Zh. tekh. Fiz., Vol. 26, No. 9, 2008-20 (1956). In Russian.

The paper is a sequel to an earlier one (Abstr. 1329/1957) where it was shown which thermal conditions existing between electrode and work-piece are of importance. First past of the present paper is theoretical and sets out to find the temperature distribution in a uniform body of infinite size heated by a source of heat on the surface for which heat emission with respect to time is known. Application of the theory to practical cases with electrodes of steel, aluminium and copper is discussed at length, the electric pulse discharge channel being regarded as the small surface source of heat. The experimentally determined relation between pit depth and current amplitude agrees satisfactorily with that predicted theoretically, the depth being only dependent on the thermal properties of the metal, the energy dissipated in the discharge channel and the dimensions of the discharge channel. C.R.S.Manders

537.523.5 : 537.527.5

4394. ON THE STABILITY LIMITS OF SWITCHING ARCS. O.Mayr.
Appl. sci. Res. B., Vol. 5, No. 1-4, 241-7 (1955). In German.

Describes the properties of d.c. arcs carrying a superimposed a.c. The effect of a cross-blast on arc properties is also dealt with and the oscillations shown on voltage oscillograms for various parallel capacitances etc. are described. J.D.Craggs

537.523.5 : 535.338.334

FORM AND WIDTH OF SPECTRAL LINES IN A D.C. ARC.
See Abstr. 4142

537.525

4395. PROBE STUDIES UNDER SILENT ELECTRIC DISCHARGE. D.P.Jatar and H.D.Sharma.
Res. Bull. Saugar Univ. Phys. Soc., Vol. 1, No. 1, 14-18 (April, 1956).

Applicability of the Langmuir's electrical probe method for the a.c. silent electric discharge has been investigated. The data reported are essentially qualitative but it is suggested that quantitative studies may also be made if certain precautions are taken. A.

537.525

4396. THE STUDY OF ELECTRONEGATIVE DISCHARGES. R.L.F.Boyd.
Appl. sci. Res. B, Vol. 5, No. 1-4, 55-6 (1955).

Results of a theoretical study of the operation of probes in the presence of negative ions are given, and probe methods being used

for measuring: (i) the concentration of various ion species and (ii) the electron energy distribution in such discharges are outlined. J.Dutton

537.525

4397. AUDIOFREQUENCY OSCILLATIONS IN LOW-PRESSURE MERCURY DISCHARGES. E.Rohner.
Appl. sci. Res. B, Vol. 5, No. 1-4, 90-6 (1955). In German.

Describes an experimental tube for studying the oscillations. The latter are shown oscillographically and discussed in terms of the Tonks–Langmuir formula for ion oscillations. J.D.Craggs

537.525

4398. DISTRIBUTION FUNCTIONS OF ELECTRONS IN A DISCHARGE. M.Bayet, J.L.Delcroix and J.F.Denisse.
Appl. sci. Res. B, Vol. 5, No. 1-4, 331-3 (1955). In French.

Claims to show that the usual explanation of the Maxwellian velocity distribution of plasma electrons and its isotropy is unsatisfactory. A mathematical treatment is sketched according to which the distribution function is developed in series of spherical harmonics Y_l^m which have been proved, by the authors, (Abstr. 8978/1954; 2776/1955) to be eigenfunctions of the collision operator. It is stated without proof, that for weak external fields anisotropies proportional to E_1 persist, neither is there a stationary state. This is so for vanishing ratio of m/M. Considering the electron mass finite but m/M small, a study of the isotropic component is said to reach the conclusion that a Maxwellian temperature at the temperature of the molecules tends to be established as a consequence of the collisions. A stationary solution involving non-Maxwellian isotropies can be found. It is suggested that the correct theory should take account of collective interaction between the electrons. H.Motz

537.525

4399. A PHENOMENOLOGICAL THEORY OF THE CONSTRICTED GAS DISCHARGE AT MODERATE CURRENTS. W.B.Thompson.
Atomic Energy Res. Establ. (Harwell) Rep. T/R997, 12 pp. (1955).

The starting point is the assumption that the electron distribution depends on the combined but independent action of the electric and magnetic fields. The main lines of the Langmuir–Tonks theory of low-pressure discharge are followed, and expressions for the potential distribution, electron temperature and power dissipated are derived. The results are limited to cases where the pressure is sufficiently high to permit the use of the diffusion equation to describe the radial motion of the ions, and where the degree of ionization is sufficiently low to justify the neglect of electron–ion and ion–ion collisions. The results show a decrease in the electron temperature as the current is increased, in accordance with experimental observation. The axial field also decreases with increasing current, so that a maximum value of the power dissipation obtains at a particular value of the current. Results for mercury at pressures of 0.076 mm, 0.76 mm and 7.6 mm of mercury are presented in a series of curves. E.A.Ash

537.525

4400. THE COMPLEX CONDUCTIVITY OF THE PLASMA OF A D.C. SUSTAINED ARC DISCHARGE. J.Kracík.
Czech. J. Phys., Vol. 6, No. 4, 376-89 (Aug., 1956).

An expression is sought for the complex conductivity of the plasma of an arc discharge sustained by a strong direct current for the case where a very weak high-frequency current passes through the plasma without influencing it in any way. The agreement between the results obtained and the existing concepts is satisfactory. A.

537.525

4401. RELATIVISTIC PLASMA OSCILLATIONS. A.Akhiezer and R.Polovin.
Dokl. Akad. Nauk SSSR, Vol. 102, No. 5, 919-20 (1955). In Russian.

A sequel to the work of Akhiezer and Lyubarskiĭ (see Abstr. 2848/1952). No limits are assumed here for the velocity of plasma electrons. As in the earlier paper no account is taken of temperature effects, i.e. the plasma temperature is assumed zero when the plasma state is characterized by an electron density depending on coordinates and time and not by a distribution function. The paper examines the problem, in such circumstances, of the wave motion of an infinite plasma. The case of longitudinal plasma oscillations is considered. C.R.S.Manders

537.525

4402. NON-LINEAR THEORY OF LONGITUDINAL PLASMA OSCILLATIONS. R.V.Polovin.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 354-5 (1956). In Russian.

In two earlier papers (Abstr. 2848/1952 and preceding abstract) non-linear unidimensional electron plasma oscillations were considered without taking account of temperature effects upon electron density, electric field and electron velocity. In the present paper an arbitrary dependence of these quantities upon distance and time is assumed and the results of the above two papers confirmed, i.e. in the non-relativistic case the frequency of plasma oscillations is found independent of amplitude. The whole derivation is enormously simplified if the basic equations are transformed from the Euler to the Lagrangian form. C.R.S.Manders

537.525

4403. THE EFFECT OF A LONGITUDINAL MAGNETIC FIELD ON A HEAVY-CURRENT PULSED GAS DISCHARGE. A.L.Bezbatchenko, I.N.Golovin, D.P.Ivanov, V.D.Kirillov and N.A.Yavlinskiĭ.
Dokl. Akad. Nauk.SSSR, Vol. 111, No. 2, 319-21 (1956). In Russian.

Several workers (J. nuclear Energy, Vol. 4, No. 2, 203-8, 209-12, Feb., 1957. English translation of articles in: Atomnaya Energiya, Vol. 1, No. 3, 1956) have shown that a heavy-current pulse gives a discharge which contracts (pinch effect), oscillates radially once or twice and then becomes unstable. The effect of a longitudinal magnetic field upon the plasma column of such discharges in deuterium was observed. Currents of 700 kA were used, fields up to 12 000 oersteds. Photographs of the discharge were taken at 2×10^6 frames per second. The photographs show that the duration of a sharply defined discharge column is greater with a field than without. With increase of field the rate of decrease of the diameter of the discharge column is less than the rate of increase of the duration of stable discharge. Theoretical aspects are discussed. C.R.S.Manders

537.525

4404. CHANGE IN LIGHT OUTPUT ASSOCIATED WITH A CURRENT CHANGE OF IRRADIATION UNDER LOW-FREQUENCY DISCHARGES IN AIR. D.P.Jatar and H.D.Sharma.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1093 (Dec., 1956).

Briefly describes measurements of the intensity of light emitted from high voltage a.c. "ozonizer tube" corona discharges, with and without external irradiation. J.D.Craggs

537.525 : 535.215.9

4405. ELECTRODE LENGTH AND THE JOSHI EFFECT UNDER OZONIZER DISCHARGE. S.R.Mohanty and P.Srinivasa Rao.
J. sci. Res. Banaras Hindu Univ., Vol. 6, No. 1, 20-3 (1955-56).

The current i (in dark i_D and under light i_L) and the net Jŏshi effect $\pm\Delta i (= i_L - i_D)$ under Siemens' tube excitation increase progressively with the length l of the discharge column, at first rapidly and then slowly. The relative effect $\pm\Delta i/i_D$ is, however, not sensibly altered; this is indicative of the fact that i_D and $\pm\Delta i$ increase with l in the same proportion. A.

537.525 : 535.215.9

4406. THE POTENTIAL RANGE FOR THE OCCURRENCE OF INVERSION OF THE POSITIVE JOSHI EFFECT. S.R.Mohanty.
J. sci. Res. Banaras Hindu Univ., Vol. 6, No. 1, 58-67 (1955-56).

The positive Joshi effect $+\Delta i$, the photoincrease of the current i through gases and vapours under electrical excitation, reversibly inverts, at constant light intensity I and frequency ν, to the negative effect $-\Delta i$, the photosuppression of i, at an inversion potential V_i^I. Inversion with I, ν and under continued exposure to discharge ("ageing") occurs in the potential range $V_m - (V_i^I)$, where V_m is the minimum "threshold potential" for the onset of the self-maintained discharge and (V_i^I) the inversion potential for minimum I, ν and "ageing" for occurrence of $\pm\Delta i$. A.

537.525

4407. HELIX TYPE GASEOUS DISCHARGE NOISE SOURCES AT LOW PLASMA DENSITIES. H.Schnitger.
J. Electronics, Vol. 2, No. 4, 368-77 (Jan., 1957).

The behaviour of the positive column of a gaseous discharge in helium within a helical line as a noise source is investigated in the range of relatively low plasma densities. The use of a helical line for establishing the h.f. electric field increases considerably the possibilities for the application of the gaseous discharge noise sources and, at the same time, makes it possible to evaluate in advance the optimum design of such devices. To check the derived formulae one only has to measure the direct current conductance of the positive column, the pressure and the effective phase constant of the helical line. Good agreement was found with the measured attenuations depending upon discharge current and pressure. The measured noise figure of the plasma depending upon pressure, however resulted in too low a value, giving a maximum deviation of 29% from the values predicted by the ambipolar diffusion theory of the positive column. A.

537.525 : 537.562

4408. MICROWAVE CONDUCTIVITY OF AN IONIZED DECAYING PLASMA AT LOW PRESSURES. A.L.Gilardini and S.C.Brown.
Phys. Rev., Vol. 105, No. 1, 25-30 (Jan. 1, 1957).

Margenau's analysis for the microwave conductivity of an infinite decaying plasma in a uniform field is extended to the case of a bounded plasma in a slightly nonuniform field. It is shown that, if a power expansion is assumed for the electron-collision frequency as a function of energy, the conductivity at low pressures can be computed as a function of time and position when the spatial and time variations of the density and energy moments of the electron-distribution function are known. An approximate method, based on a conventional integration of Boltzmann equation is given to compute these quantities, when inelastic collisions can be neglected. The steady-state conductivity in the late afterglow of a diffusion-controlled decaying plasma is thus explicitly determined for two experimental conditions: a plasma filling a cubic quartz bottle centred in a parallelepiped microwave cavity and a plasma filling a quartz tube of square cross-section in a waveguide. The limit for the validity of the theory set by the appearance of inelastic collisions at high electric fields is investigated. A.

537.525 : 537.562

4409. MICROWAVE DETERMINATION OF THE PROBABILITY OF COLLISION OF ELECTRONS IN NEON. A.L.Gilardini and S.C.Brown.
Phys. Rev., Vol. 105, No. 1, 31-4 (Jan. 1, 1957).

The theory for computing the microwave conductivity of a plasma discussed in the previous paper (see preceding abstract) can be used for determining the collision probability for momentum transfer of slow electrons when the conductivity ratio of a plasma is measured as a function of the applied field. The conditions required for having a pressure-independent conductivity ratio and steady-state electron energy for a given field are investigated. The convenience of using two independent fields for measuring the conductivity and changing the electron energy is shown. Conductivity ratios measured in the afterglow of a pulsed discharge in a microwave resonant cavity are given for neon and for neon contaminated with argon. The collision probability for momentum transfer in neon computed from these data as a function of the electron velocity joins Ramsauer's and Kollath's measurements for higher electron velocities. A.

537.525

4410. EXPERIMENTAL INVESTIGATIONS OF THE MOTION OF PLASMA PROJECTED FROM A BUTTON SOURCE ACROSS MAGNETIC FIELDS. E.G.Harris, R.B.Theus and W.H.Bostick.
Phys. Rev., Vol. 105, No. 1, 46-50 (Jan. 1, 1957).

The velocity with which the plasma from a button source propagates across magnetic fields has been measured as a function of the experimental parameters. These experiments revealed that the velocity of the plasma front is a slowly varying function of the magnetic field strength from one to six kilogauss and increases monotonically with the voltage applied to the source condensers. Measurements of the arrival time of the plasma front versus distance from the source show that it moves across the magnetic field with constant velocity. When the source orientation is such that the force exerted by the magnetic field on the discharge current is in the direction of propagation the velocity is increased, and vice versa. A.

537.525

4411. HYDROMAGNETIC INSTABILITIES OF AN IDEALLY CONDUCTING FLUID. R.J.Tayler.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 31-48 (Jan., 1957).

Some hydromagnetic instabilities of a cylindrical ideally conducting fluid, which is confined by the pinch effect of an axial current, are considered. Kruskal and Schwarzschild (Abstr. 6324/1954) have previously studied the instabilities of a fluid carrying a surface current. A volume current distributed according to a power law is considered, and some general stability criteria and values of maximum possible growth rates are obtained. The volume current is more stable than the surface current, and in particular an infinite instability at short wavelength is replaced by one of finite growth rate. Finally, viscosity is introduced into the plasma carrying a surface current; disturbances at very short wavelength are damped, and a first approximation is obtained to a wavelength of maximum instability. A.

537.525 : 537.562

4412. THE COLLECTION OF POSITIVE IONS BY A PROBE IMMERSED IN A PLASMA. J.E.Allen, R.L.F.Boyd and P.Reynolds.
Proc. Phys. Soc. B, Vol. 70, Pt 3, 297-304 (March, 1957).

The theory of the collection of positive ions by a probe immersed in a low-pressure plasma is reviewed and extended. The ion current is determined mainly by the electric field which penetrates beyond the sheath edge into the plasma. Computed potential distributions for a spherical probe are presented, together with the calculated positive ion current–voltage characteristics. A.

537.525 : 539.172

APPLICATION OF PLASMA DISCHARGES IN CONTROLLED NUCLEAR FUSION. See Abstr. 3621

537.525.4 : 621.3.015.5

4413. PHENOMENA AT THE ELECTRODES DURING A POWERFUL ELECTRIC BREAKDOWN IN HIGH VACUUM. N.B.Rozanova and V.L.Granovskiĭ.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 20, No. 10, 1162-3 (1956). In Russian.

The experiments were carried out between a hemispherical cathode and a plane anode, at electrode distances 0.1-3 mm, and residual gas pressure 10^{-5} mm Hg. Relation between breakdown voltage and electrode spacing in the range 50-160 kV agreed with that derived by Cranberg from experimental results of various authors. In particular the relations between electrode materials and breakdown voltage and X-ray intensity in discharge gaps prior to breakdown were studied. Electric strength of a vacuum gap increases with increasing X-ray output in pre-breakdown period.
Electrical Research Association

537.525.5 : 535.331

4414. THE RATIO OF THE INTENSITIES OF THE OSCILLATORS OF COMPONENTS OF THE RESONANCE MULTIPLETS OF Al, Tl, Cr, Mn, Mo AND IONS OF Ba, Ca AND Sr. E.I.Nikonova and V.K.Prokof'ev.
Optika i Spektrosk, Vol. 1, No. 3, 290-7 (1956). In Russian.

The anomalous dispersion of metal vapours in the discharge of a d.c. arc was studied, the metal being introduced into a hole bored in the positive carbon electrode of the arc. The interferometer apparatus used is described in full detail. Values of the relative strengths of the oscillators of the components of certain multiplets found experimentally are in general very close to the theoretical values. C.R.S.Manders

537.525.5

4415. DETERMINATION OF THE CONCENTRATIONS OF METAL ATOMS IN THE PLASMA OF A D.C. ARC BURNING UNDER A REDUCED PRESSURE. E.I.Nikonova and V.K.Prokof'ev.
Optika i Spektrosk., Vol. 1, No. 3, 298-301 (1956). In Russian.

To estimate the number of metal atoms in an electric arc plasma is a matter of considerable interest in quantitative spectral analysis. Methods are reviewed for determining the proportionality between the atoms in the plasma and those in the electrode. In their experiments the authors employed a Rozhdestvenskiĭ interferometer (Anomalous Dispersion. D.S.Rozhdestvenskiĭ. Press of the Academy of Sciences, USSR, 1951) or that described in an earlier paper (see preceding abstract). The metal studied was carried in the hole bored through the positive carbon electrode of the arc, the pressure of the atmosphere surrounding being ~ 0.25 atm. For Fe, Cr, Al, Mn, Ca and Sr the concentrations in the plasma vary from 0.2 to 7.0%. C.R.S.Manders

537.525.8

4416. COLLISIONAL PROCESSES AND SIMILARITY UNDER THE LOW-FREQUENCY SILENT ELECTRIC DISCHARGE IN AIR. D.P.Jatar and H.D.Sharma.
J. chem. Phys., Vol. 25, No. 4, 785 (Oct., 1956).

Results of breakdown potential measurements in two similar coaxial cylinder systems (Siemen's-type all-glass ozonizers) are given in graphical form. The similarity theorem is obeyed showing that all ionization processes in such discharges are functions of the ratio field–pressure only. J.Dutton

537.525.8

4417. MOVING STRIATIONS. N.L.Oleson and A.W.Cooper.
Phys. Rev., Vol. 105, No. 4, 1411 (Feb. 15, 1957).

Briefly summarizes the results of observations on moving striations in neon (mm pressures) using a wide variety of techniques simultaneously. Electron temperatures range from 20 000 to 50 000° K. Electron densities (probe data) ranged from 7×10^8 to $4.3 \times 10^9/cm^3$. J.D.Craggs

537.527.5 : 536.52

4418. THE TEMPERATURE MEASUREMENT OF ARCS USED FOR THE TREATMENT OF MATERIALS IN PRESSURE CHAMBERS. H.Meincke.
Schweiz. Arch. angew. Wiss. Tech., Vol 22, No. 9, 282-9 (Sept., 1956). In German.

A general discussion of problems relating to the temperature measurement of arcs used for preparation of refractory solids etc. For example, temperature distributions round arcs are discussed briefly. J.D.Craggs

537.529

4419. DISRUPTIVE DISCHARGE IN CdS SINGLE CRYSTALS. J.Woods.
J. Phys. Radium, Vol. 17, No. 8-9, 718 (Aug.-Sept., 1956). In French.

X-RAYS 537.531

537.531

4420. SAFE AND SIMPLE X-RAY DEMONSTRATION USING A CATHODE-RAY TUBE AND A GEIGER COUNTER. A.V.Baez.
Amer. J. Phys., Vol. 24, No. 8, 583-4 (Nov., 1956).

Using a Crooke's tube actuated by a small induction coil which may give 80 kV at only 10^{-4} A, laboratory demonstrations of properties of X-rays and cathode rays may be made using a Geiger counter as detector. The dosage near the tube is of the order of 5×10^{-3} r/hr. D.V.Mabbs

537.531 : 539.163.2

4421. PLATINUM K X-RAYS FROM RADIUM SOURCES. J.Cederlund.
Ark. Fys., Vol. 11, Paper 36, 431-5 (1957).

The platinum K X-rays generated in the walls of a radium container were studied with a scintillation spectrometer. Special measures were adopted to reduce and correct for the strong Compton background due to the hard gamma-rays from radium. A source, the rays of which simulated the hard beta rays from RaC, was used to estimate what a proportion of the observed peak was due to beta rays from RaC. The number of photons in the K X-ray peak was found to be 0.030 per radium disintegration, or 1.4% of the total number of photons emitted from the source. A.

537.531 : 535.345

4422. SEMIEMPIRICAL DETERMINATION OF MASS ABSORPTION COEFFICIENTS FOR THE 5 TO 50 ANGSTROM X-RAY REGION. B.L.Henke, R.White and B.Lundberg.
J. appl. Phys., Vol. 28, No. 1, 98-105 (Jan., 1957).

A semiemperical method for the determination of mass absorption coefficients for the very soft X-ray region of 5 to 50 A is described. A universal function for the absorption by K-shell electrons and another for absorption by L and extra L-shell electrons are given in table form to permit the calculation of mass absorption coefficients for elements of atomic number up to 36. Calculated and observed values from available absorption data are compared with those predicted by quantum theory. Tables are given for the mass absorption coefficients for nine useful wavelengths in the ultra-soft region, 8.34, 13.3, 17.6, 21.7, 23.7, 27.4, 31.6, 36.3, and 44 A. A.

537.531 : 535.39

4423. SPECTRAL REFLECTANCE OF SOLIDS FOR ALUMINUM K RADIATION. R.W.Hendrick.
J. Opt. Soc. Amer., Vol. 47, No. 2, 165-71 (Feb., 1957).

The fraction of aluminium K radiation reflected from flat glass, magnesium, aluminium, copper, silver and gold surfaces was measured as a function of the angle of grazing incidence. A single vacuum chamber enclosed the 0.01 in. diameter, aluminium wire anode X-ray tube, 15 μ thick absorption filter, CeBr(Tl) scintillator, refrigerated 6199 photomultiplier, reflecting surface, and metal evaporation source. The metallic surfaces were films deposited on glass flats already placed in position for immediate reflectance measurements. A linkage caused the X-ray beam to impinge on a fixed portion of the scintillator to avoid detector nonuniformities, and the photomultiplier-detector was cooled with ice water to reduce thermal noise. Excluding two anomalous cases, the critical angles average 9.3% below theoretical calculated values, and absorption ratios 28.2% above. A reduced material density could account for the low critical angle, but no simple explanation was conceived to account for the absorption discrepancy. Interference extremes produced by reflection from the aluminium film were in agreement with predictions of a revised interference theory. A.

537.531 : 535.33.07

4424. A BENT CRYSTAL X-RAY SPECTROGRAPH. G.B.Deodhar and R.C.Karnatak.
J. sci. Instrum., Vol. 34, No. 1, 21-3 (Jan., 1957).

Details of the principle and construction of a new design of bent crystal spectrograph of the transmission type are described. Different possible settings of the instrument with respect to the X-ray beam are discussed and advantages over the previous designs pointed out. A.

537.531 : 535.331

4425. FLUORESCENCE YIELDS OF Ni, Cu, Zn, AND Pb. E.T.Patronis, Jr, C.H.Braden and L.D.Wyly.
Phys. Rev., Vol. 105, No. 2, 681-2 (Jan. 15, 1957).

A new method for measuring fluorescence yields is described. The method employs a radioactive source for fluorescence excitation and a proportional counter as a radiation detector. The K-shell fluorescence yields for Ni, Cu, and Zn were found to be 0.33 ± 0.02, 0.39 ± 0.02, 0.44 ± 0.02, respectively. The mean L-shell fluorescence yield of Pb was found to be 0.39 ± 0.02. A.

537.531 : 535.331

4426. K FLUORESCENCE YIELD OF SEVERAL METALS. C.E.Roos.
Phys. Rev., Vol. 105, No. 3, 931-5 (Feb. 1, 1957).

The K fluorescence yield (w_K) of iron, nickel, copper, and zinc has been measured by the solid angle method. By varying the solid angle subtended by a sample foil at a NaI(Tl) crystal one can distinguish between the collimated primary beam and the isotropically emitted fluorescent X-rays. The following new values were obtained: iron -0.308 ± 0.015, nickel -0.366 ± 0.011, copper -0.410 ± 0.012, and zinc -0.446 ± 0.012. In addition, the values for the K fluorescence yield of zirconium, niobium, molybdenum, rhodium, palladium, silver, cadmium, and tin reported earlier, have been redetermined. With the single exception of the value for zirconium, these new values agree quite closely with the earlier values. The average change is approximately 1% or about one third of the previously estimated error. The redetermined values of w_K are as follows: Zr -0.70 ± 0.02, Nb -0.73 ± 0.02, Mo -0.73 ± 0.02, Rh -0.786 ± 0.015, Pd -0.790 ± 0.015, Ag -0.821 ± 0.019, Cd -0.827 ± 0.015, Sn -0.846 ± 0.012. A phosphorescence of the NaI(Tl) crystals with a decay time of 8 ± 2 msec was found, while no sign of a reported 0.2 msec decay was observed. A.

537.531 : 535.343

4427. K X-RAY ABSORPTION SPECTRUM OF A SINGLE CRYSTAL OF GERMANIUM. D.G.Doran and S.T.Stephenson.
Phys. Rev., Vol. 105, No. 4, 1156-7 (Feb. 15, 1957).

The extended fine structure on the short wavelength side of the K X-ray absorption edge of Ge in a thin single crystal of Ge has been studied by using a double-crystal spectrometer. Extended structure was obtained out to 300 eV from the main edge. Positions of the structure observed are given. A.

537.531 : 535.343

4428. "THICKNESS EFFECT" IN ABSORPTION SPECTRA NEAR ABSORPTION EDGES. L.G.Parratt, C.F.Hempstead and E.L.Jossem.
Phys. Rev., Vol. 105, No. 4, 1228-32 (Feb. 15, 1957).

The details of an observed absorption spectrum are shown to depend upon the thickness of the absorber. This effect is present, at least in principle, regardless of the type of radiation involved. It is discussed here specifically for X-rays, and specifically for the neighbourhood of an absorption edge. Measurements of widths and of relative intensities of the component structure are the most sensitively involved, but wavelengths are also slightly affected. The explanation lies in the role of the effective spectral window of the spectrometer. The effect may be serious when the "tails" of the window are extensive, as is inevitably the case with two-crystal X-ray spectrometers. Features of the extent and shape of the spectral window for the $(1,+1)$ position of the instrument used in this work are roughly determined from the thickness effect. A.

537.531 : 535.33

4429. SELF-ABSORPTION IN THE X-RAY SPECTROSCOPY OF VALENCE ELECTRONS. H.P.Hanson and J.Herrera.
Phys. Rev., Vol. 105, No. 5, 1483-5 (March 1, 1957).

It is shown that target self-absorption has modified some $K\beta_5$ emission profiles previously observed. The effect has been to produce an exaggerated asymmetry, to depress certain satellites, and to produce an apparent coincidence of the absorption and emission edges. A.

537.531.8

4430. THE K AUGER YIELD FOR TIN. J.A.V.Fairbrother, D.G.Parkyn and B.M.O'Connor.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 262-74 (April, 1957).

The principle employed by Martin and Stockmeyer in their determination of the fluorescent yield for gases is extended in the

present paper to a determination of the fluorescent yield for metals. Preliminary measurements, using Burhop's probability values for the possible Auger transitions, give 0.164 ± 8% as the K Auger yield for tin or 0.836 ± 1.5% for the fluorescent yield. Though not forming part of the present paper the method allows the relative probability of the possible Auger transitions to be determined. A.

CATHODE RAYS. POSITIVE RAYS 537.533/.534

537.533

4431. FIVE FIGURE TABLES FOR THE CONVERSION OF ELECTRON MOMENTUM TO ELECTRON KINETIC ENERGY FROM 100 TO 20 000 GAUSS-CM. J.L.Wolfson and H.S.Gellman.
Atomic Energy of Canada Rep. 327, 43 pp. (Jan., 1954).

537.533 : 621.385.1.029.6

4432. THE MEASUREMENT OF SPACE CHARGE WAVELENGTH IN AN ELECTRON BEAM. D.Walsh.
J. Electronics, Vol. 2, No. 5, 436-40 (March, 1957).

A method is described of measuring the wavelength of space-charge waves in an electron beam by comparing the klystron gain between cavities unequally spaced along the beam. A.

537.533

4433. ON THE INFLUENCE OF RADIATION ON THE SYNCHROTRON OSCILLATIONS OF ELECTRONS IN STRONG FOCUSING DEVICES. A.N.Matveev.
Dokl. Akad. Nauk SSSR, Vol. 108, No. 3, 432-5 (1956). In Russian.

The investigation is limited to the high energy field. The differential equation for the phase oscillation is deduced for each of the two cases where the quantum character of the radiation is (a) neglected and (b) taken into account. The mean square deviation for this last case is given. A comparison with the weak focusing case proves that strong focusing considerably reduces the amplitude of the oscillations and in practice its adoption may become compulsory when approaching energies of the order of some BeV. Design figures for a practical case are given. G.Martelli

537.533

4434. CYCLOTRON WITH SECTIONAL MAGNET SYSTEM. E.M.Moroz.
Dokl. Akad. Nauk SSSR, Vol. 108, No. 3, 436-9 (1956). In Russian.

The motion of particles in a cyclotron with a d.c. magnet consisting of a number of similar wedge-shaped sections is investigated. The frequency of the revolution of the particles may be kept constant without a radial increase of the magnetic field. The principle of construction of the device is discussed, and the stability of the motion as well as the limits imposed by resonance conditions are deduced. It is suggested that the method might be successfully applied to the magnetic fields of microtrons. G.Martelli

537.533

4435. A METHOD OF MEASURING THE RADIAL PHASE OSCILLATIONS OF ELECTRONS IN A SYNCHROTRON. Yu.M.Ado.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 533-4 (1956). In Russian.

The method is based on the detection of the radiation from electrons circulating in a synchrotron. The radiation is strongly directed along the tangent to the electron orbit, so it can be detected as short light pulses (fine structure of the radiation), the duration and the shape of which depend on the amplitude of the synchrotron oscillation of the beam. The light detector consists basically of a Kerr cell filled with nitrobenzole. The condenser of the cell is conveniently coupled to the synchrotron generator. On the basis of simple physical considerations the relationship between the transmitted light pulses and the characteristics of the synchrotron oscillations of the electrons are deduced. G.Martelli

537.533

4436. THEORY OF BETATRON OSCILLATIONS OF PARTICLES IN MAGNETIC SYSTEMS. I. A.A.Kolomenskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 9, 1969-77 (1956). In Russian.

The physical problem of charged particle motion in variable magnetic fields is discussed with a view to formulating a very general and coherent mathematical theory. The equations of betatron oscillations (assumed by the author to mean broadly the motion of a particle in a periodic magnetic field in a region surrounding a preset curve which is not necessarily plane) are deduced, and some particular cases are studied. G.Martelli

537.533

4438. THE STEREOBETATRON. V.A.Moskalev.
Zh. tekh. Fiz., Vol. 25, No. 9, 2060-1 (1956). In Russian.

The device consists of a betatron with two accelerating chambers, placed in the same magnet. The two beams may be focused at a preset distance from the magnet, so as to allow a spatial reconstruction of the irradiated objects. The device should prove particularly suitable for localizing the depth of defects in thick metal specimens; it may also be useful for medical purposes, since the intensity at an internal point of the body may be doubled without exceeding the safety dose on the skin. G.Martelli

537.533

4437. THEORY OF BETATRON OSCILLATIONS OF PARTICLES IN MAGNETIC SYSTEMS. II. A.A.Kolomenskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 9, 1978-90 (1956). In Russian.

The motion of particles in magnetic periodic fields, under the action of perturbations giving rise to both linear and nonlinear resonances, is investigated with the aid of general method developed in Pt I. The results may be applied to any system satisfying some general conditions, but particular attention is given by the author to the requirements of strong-focusing devices. G.Martelli

537.533.1

4439. DRIFT VELOCITIES OF ELECTRONS IN SOME COMMONLY USED COUNTING GASES. T.E.Bortner, G.S.Hurst and W.G.Stone.
Rev. sci. Instrum., Vol. 28, No. 2, 103-8 (Feb., 1957).

The original method of Stevenson has been used to develop an apparatus capable of yielding high precision for the drift velocities of electrons moving in an electric field. Measurements have been made of the electron drift velocity in argon, nitrogen, methane, carbon dioxide, ethylene, cyclopropane, and a few mixtures of some of these gases. The results for argon and nitrogen agree with those of Nielsen. A.

537.533.2

4440. ON PRODUCTION OF A PENCIL OF POLARIZED ELECTRONS. L.N.Rozentsveĭg.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 520-1 (1956). In Russian.

Several methods are currently known for obtaining beams of polarized electrons but none of them is effective when high energies are concerned. The present paper considers the conditions obtaining when a self-emitting cathode has strong H and E fields perpendicular to its surface and it is shown that the possibility of obtaining a heavy source of polarized electrons is essentially that of finding a cathode giving considerable cold-emission current at intensities of electric field of $\sim 10^6$ V/cm and at temperatures of some 20^0 K. Attention is drawn to a paper (Abstr. 4669/1951) describing how to obtain pulsed fields of high intensity and short duration that will enable the full project to be carried out. C.R.S.Manders

537.533.3 : 537.534.3

4441. STABILITY OF PERIODIC-FIELD BEAM FOCUSING. K.K.N.Chang.
J. appl. Phys., Vol. 27, No. 12, 1527-32 (Dec., 1956).

By taking into consideration both the effects of space-charge and large-amplitude scalloping, an analytic solution for periodic-field beam focusing is obtained through use of successive approximation and Fourier series expansion. The stability limit is then determined by studying a perturbation of the obtained solution. The perturbation results in a Hill's differential equation for the incremental beam radius. This equation yields a stability criterion for periodic-field beam focusing. It is found that instability starts at some degree of beam scalloping and ends at a higher one, and thus forms an unstable band. A.

537.533.3

4442. FORMATION OF HIGH-DENSITY ELECTRON BEAMS. G.R.Brewer.
J. appl. Phys., Vol. 28, No. 1, 7-15 (Jan., 1957).

The physical principles underlying the design and performance of electron guns suitable for the generation of high-density electron beams (beam-current density of the order of 200 A/cm^2) are discussed. Initiation of the flow of a cylindrical electron beam focused by a uniform magnetic field is described, with emphasis on the design of the electron gun. The principles underlying the Pierce design procedure for space-charge limited electron guns is treated, including the limitations and the modifications necessary when used for very high-density beams. Means are suggested for partial compensation of the electric field distortion due to the anode aperture of the gun. The effects on the beam and resulting limitations in gun design due to thermal velocities of emission are described. The experimental techniques for study of gun and beam performance are

described, together with some results of these studies. These techniques include detailed measurement of beam characteristicis, such as current density and transverse velocity distributions, both with and without a magnetic field. These measurements illustrate a number of deviations of actual electron flow from that usually considered in the simple theories. A.

537.533.33

4443. GEOMETRICAL ABERRATIONS IN STRONG ELECTRON LENSES. M.Y.Bernard and J.Hue.
C.R. Acad. Sci. (Paris), Vol. 243, No. 23, 1852-4 (Dec. 5, 1956). In French.

A perturbation method for the determination of the geometrical aberrations of strong electron lenses, in terms of a certain potential coefficient which can be accurately measured, is briefly described. A.E.I. Research Laboratory

537.533.332

4444. STUDY OF THE STRAY FIELDS OF A 4-POLE MAGNETIC LENS. A.Septier.
C.R. Acad. Sci. (Paris), Vol. 243, No. 15, 1026-9 (Oct. 8, 1956). In French.

The field distribution of a quadrupolar magnetic electron-lens near its ends is examined. Within distances from the ends roughly equal to half the separation of opposite pole pieces considerable variations are shown to occur. It is deduced that for favourable operation electrons should be kept well away from the magnetic material. A.E.I. Research Laboratory

537.533.35

4445. IMPROVEMENT IN THE RESOLVING POWER OF THE EMISSION ELECTRON MICROSCOPE. C.Fert and R.Simon.
C.R. Acad. Sci. (Paris), Vol. 243, No. 18, 1300-3 (Oct. 29, 1956). In French.

A new apparatus is described for emission electron microscopy. Electrons are emitted from the specimen during a suitably controlled ion bombardment. The magnetic imaging lens is designed to allow a high electric field to be used at the specimen. An aperture is provided to limit the beam angle. Resolutions of 250 A.U. are claimed. A.E.I. Research Laboratory

537.533.35

4446. THE USE OF A 4-POLE MAGNETIC LENS TO REDUCE THE "DISTORTION" OF THE IMAGE IN REFLECTION ELECTRON MICROSCOPY. C.Fert and R.Saporte.
C.R. Acad. Sci.(Paris), Vol. 243, No. 16, 1107-10 (Oct. 15, 1956). In French.

In a previous paper (Abstr. 2169/1956) a sphero-cylindical electrostatic lens was described which corrected the characteristic "distortion" that occurs in reflection microscopy. The same correction can be made more conveniently with a four-pole magnetic lens placed after the projector lens. Design data are given and an example of its use in reflection microscopy described.
A.E.I. Research Laboratory

537.533.35 : 539.165.08

4447. INTERMEDIATE-IMAGE PAIR SPECTROMETER. D.E.Alburger.
Rev. sci. Instrum., Vol. 27, No. 12, 991-1004 (Dec., 1956).

An iron-free intermediate-image beta-ray spectrometer has been constructed having a momentum spread (full width at half-maximum) for a point source of conversion electrons continuously variable between limits of 0.5% and 4% with corresponding transmissions of 1% and 8% of 4π, respectively. The line halfwidth contribution due to source size is 0.3% per mm of diameter. At a power dissipation of 100 kW the spectrometer focuses electrons of 9 MeV energy allowing positron—electron pair lines corrsponding to transitions of up to 19 MeV to be measured using a double-crystal statistical-separation detector together with a fast coincidence circuit. In tests with the 6 MeV nuclear transition in O^{16} using a Van de Graaff beam spot 1 mm diameter the momentum half-width of the pair line can be varied from 0.56% to 2.5% with corresponding absolute transmissions of 0.07 to 6.3 pair counts per 10^5 source transitions, respectively. The energy of this transition has been determined as 6.065 ± 0.009 MeV. Electron—gamma and electron—electron coincidence measurements on radioactive sources may be made with the spectrometer in conjunction with crystal detectors placed near the source. A.

537.533.35 : 539.165.08

4448. LINE SHAPES AND INTENSITIES FOR DISK SOURCES USED IN AN HOMOGENEOUS MAGNETIC FIELD BETA-RAY SPECTROMETER WITH NEW AND CONVENTIONAL SLIT GEOMETRIES. D.B.Beard.
Rev. sci. Instrum., Vol. 28, No. 1, 19-27 (Jan., 1957).

Is primarily concerned with the effect on the line profile shape and intensity of the angle φ, the angle made by the projection of the electron velocity vector on a plane perpendicular to the instrument axis at the source with the radius of the source point. Quantitative results are quoted for several geometries. The line profile, expected intensity, and optimum source size for a commonly used slit geometry utilizing an entrance slit for take-off angle selection is found to differ significantly from previously quoted results, the intensity for the same half-width for optimum source size being 46% of the earlier work. A new slit geometry consisting of an additional baffle near the source which restricts φ is discussed and is found to improve the expected intensity for the same line half-width by 24% for an optimized Hubert slit system which is already found in this paper to be 28% better than the best of previous slit geometries. Finally, a geometry which selects φ properly is shown to remove all dependence on source size from the resolution. A.

537.533.35

4449. A METHOD OF MEASURING HIGH RELATIVE INTENSITIES OF POSITIVE AND NEGATIVE ELECTRONS. G.Tisljar-Lentulis and P.Weinzierl.
S.B. Österr. Akad. Wiss. IIa, Vol. 164, No. 5-7, 255-65 (1955). In German.

Describes a trochoidal-beam spectrometer for measuring electron and positron beam intensities. Experimental results are shown. J.D.Craggs

537.533.35

4450. VERTICAL FOCUSING IN A SPIRAL ORBIT β-SPECTROMETER. V.S.Shpinel' and O.Sh.Groĭs.
Zh. tekh. Fiz., Vol. 26, No. 10, 2259-68 (1956). In Russian.

Calculations are presented of spatial trajectories in a spiral orbit β-spectrometer illustrating the nature of vertical focusing of electrons. Focusing properties of the spectrometer were studied using a photographic method. The investigations disclose the existence of a sharp focus which has the appearence of a narrow band drawn out along the radius. Z.Krasucki

537.533.74 : 539.181

4451. RADIATIVE COLLISIONS BETWEEN ELECTRONIC AND MOLECULAR BEAMS. I. ANGULAR MOMENTUM DISTRIBUTION AMONG OH* RADICALS RESULTING FROM H_2O MOLECULES. T.Horie, T.Nagura and M.Otsuka.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1157-70 (Nov., 1956).

The angular momentum distributions among the OH* radicals in radiative collisions between electronic and water molecular beams in the vacuum of 1×10^{-4} mm Hg lead to the following predictions as regards the mechanism of the radiative decomposition of H_2O. (1) The relative number of the abnormally rotating OH* radicals to the thermally rotating ones, both coming out of water molecules excited by electron-impacts, is on the average 10 to 1. (2) Two different kinds of singlet excited states of water molecules play leading parts in the radiative collisions; one is caused by the excitation of the oxygen (2p) electron up to the (3s) orbital, and the other by the simultaneous excitations of the oxygen (2p) and the hydrogen (1s) electrons up to their respective orbitals with higher principal quantum numbers. (3) The abnormally rotating OH* radicals result from the former and the thermally rotating ones from the latter. (4) The recoiling H atom flies off nearly in the direction of the H—H repulsion with the highest probability. A.

537.533.74

4452. A COMPARISON OF ELECTRON AND POSITRON SINGLE SCATTERING IN ARGON. C.Bowness and N.Cusack.
Phil. Mag. (Eighth Ser.), Vol. 2, 196-203 (Feb., 1957).

A combination of lens spectrometer and diffusion cloud chamber was used to study the difference in the scattering of 0.3 MeV positrons and electrons by argon. 611 electron and 506 positron scatters were observed with projected angles $\phi > 30^0$. The ratio of the number of electron scatters per unit track length to that of positrons was 1.21 with a standard error of 6%; the theoretical value is 1.18. The measured absolute value of the cross-section agreed with the theoretical value within the experimental error of about 10%. A.

537.533.74

4453. MEASUREMENT OF THE RADIATIVE CORRECTION TO ELECTRON—PROTON SCATTERING BY OBSERVATION OF THE ABSOLUTE CROSS SECTION. G.W.Tautfest and W.K.H.Panofsky.
Phys. Rev., Vol. 105, No. 4, 1356-68 (Feb. 15, 1957).

The scattering of 139.5 MeV electrons in hydrogen gas at 1 atm

pressure has been investigated using photographic emulsions. The beam of electrons from the Stanford Mark III linear accelerator, collimated to a diameter of $\frac{1}{16}$ in., passed through the gas and was collected in a lead Faraday cup. Ilford C-2 emulsions, 50 μ thick, which were arranged symmetrically about the beam, detected the recoil protons. Measurements of the recoil angle γ and the range in the emulsion were made on the proton tracks. Only those events were accepted whose measured range and angle correlated within ± 2.33 standard deviations of the distribution about the elastic kinematic range-angle curve calculated from the multiple scattering in the emulsion and the uncertainty in angle measurement. A total of 2350 tracks have been tabulated in the angular interval $54^0 \leq \gamma \leq 78^0$ giving a statistical error matching the systematic errors in plate geometry, beam integration, and track measurement. The results are compared with the Mott cross-section integrated over the interval. The theoretical cross-section was corrected for (a) proton recoil, (b) the proton magnetic moment, (c) the finite size of the proton's charge and magnetic moment, (d) the radiative correction, including the effect on the cross-section of emission of real photons contributing to the observed recoil protons. The result is

$$\sigma_{exp}/\sigma_{theor} = 0.988 \pm 0.021 \text{ (probable error)},$$

using a proton radius of 7.7×10^{-14} cm, and including a 2.74% radiative correction; the result is not sensitive to the choice of proton radius. A.

537.533.74

4454. HIGHER ORDER RADIATIVE CORRECTIONS TO ELECTRON SCATTERING. D.R.Yennie and H.Suura.
Phys. Rev., Vol. 105, No. 4, 1378-82 (Feb. 15, 1957).

The higher order radiative corrections are examined in the infrared region, and Schwinger's conjecture regarding the functional dependence of these corrections on the energy solution is proved. A.

537.533.74 : 537.534.74

4455. THE MULTIPLE SCATTERING OF POSITRONS AND ELECTRONS. C.Henderson and A.Scott.
Proc. Phys. Soc. A, Vol. 70, Pt 3, 188-94 (March, 1957).

The multiple scattering of electrons and positrons at an energy of 0.4 MeV has been measured with a scintillation counter. The difference between the distribution width for electrons and that for positrons after scattering by aluminium, silver and gold is smaller than previous measurements have indicated, and is given approximately by the calculations of Mohr (Abstr. 11120/1954). Further work with electrons only, using silver and Ilford-G5 emulsion as the scattering foil material shows good agreement with the theory of Molière (Abstr. 609/1949). A.

537.533.74 : 539.153.4

4456. ON THE THEORY OF THE INELASTIC SCATTERING OF ELECTRONS BY HELIUM ATOMS. W.F.Miller and R.L.Platzman.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 299-303 (April, 1957).

The familiar relationship between the optical properties of an atom and its cross-sections for inelastic electron collisions can provide a valuable criterion for the validity of such cross-sections. A method of exploiting this relationship is explained and then illustrated by application to two transitions of helium (transitions to the $2\ ^1P$ state, and to the ionization limit), thereby correcting erroneous cross-sections of long standing in the literature. Other applications are suggested, and a general proposal for obtaining more accurate cross-sections is advanced. A.

537.533.8

4457. BREMSSTRAHLUNG MEASUREMENTS WITH A COMPTON ELECTRON SPECTROMETER. J.W.Robson and E.C.Gregg.
Phys. Rev., Vol. 105, No. 2, 619-27 (Jan. 15, 1957).

A method of analysing the data obtained from a Compton electron spectrometer in order to obtain the incident photon spectrum is described. Practical considerations limit the application of this analysis to photon energies above about 5 MeV. Application of this analysis to a measurement of the spectrum of the Case betatron is described. A.

537.533.8 : 539.234

4458. THE ELECTRON BOMBARDMENT OF THIN BARIUM FILMS. L.Jacob.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 235-9 (Feb., 1957).

Experiments are described which show that it is possible to transfer barium from an anode as a thin film to a cathode by simple electron bomardment. This effect appears to occur with the anode cold. The "threshold" bombarding energy is about 300 volts for barium; the corresponding current density at the target is of the order of 1 mA cm^{-2}. The gradual build-up of thin film activity of a pure strontium oxide cathode was followed with time. The final result was an emitter whose performance matched that of the standard BaO/SrO cathode in every way; the thin film emitter, however, exhibits a large temperature dependence but has high tenacity. A.

537.533.8

4459. SHOWERS IN LEAD, PRODUCED BY ELECTRONS WITH 360 ± 30 MeV ENERGY. V.G.Ivanov, N.I.Petrov, V.A.Rusakov, Yu.A.Budagov and V.T.Osipenkov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1095-6 (1956). In Russian.

In experiments with a synchrocyclotron a beam of π-mesons was produced containing $(2 \pm 1)\%$ electrons with energies 330-390 MeV. This beam falling on a Pb plate (4.6 g/cm^2) in a 40 cm cloud chamber in a magnetic field of 10^4 Oe gave, besides the records of interactions of negative π-mesons with Pb nuclei, records of some 159 showers of electron–positron pairs due to the high-energy electrons. A table summarizing data concerning the 159 showers and a graph of the energy distribution of the secondary electrons are given. C.R.S.Manders

537.533.8

4460. SECONDARY ELECTRON EMISSION FROM NICKEL AND MOLYBDENUM AT LOW ENERGIES OF PRIMARY ELECTRONS. A.R.Shul'man and E.I.Myakinin.
Zh. tekh. Fiz., Vol. 26, No. 10, 2223-33 (1956). In Russian.

Secondary emission from nickel and molybdenum has a threshold at the energy of primary electrons, V_p, a little greater than the metal work function. With increasing V_p the average energy of secondary electrons increases. These facts can be explained if one assumes the scattering of electrons to be spherically symmetric for low values of V_p. Z.Krasucki

537.533.8

4461. SPATIAL DISTRIBUTION OF BETATRON RADIATION AT 10 MeV. V.A.Moskalev.
Zh. tekh. Fiz., Vol. 26, No. 11, 2595-8 (1956). In Russian.

The paper describes experiments intended to check Lawson's theoretical results (J.S.Lawson, Abstr. 5883/1950). Agreement with theory regarding position of the maximum and width of the radiation cone is found. A second maximum is shown to come from low-energy radiation and some qualitative reasons for its occurrence are given. H.Motz

537.533.9 : 539.4.019

ANNEALING OF COLD-WORKED COPPER BY ELECTRON IRRADIATION. See Abstr. 3771

537.534

4462. LINEAR THEORY OF BETATRON OSCILLATIONS IN SECTORIAL CYCLOTRONS. L.C.Teng.
Rev. sci. Instrum., Vol. 27, No. 12, 1051-8 (Dec., 1956).

In a sectorial cyclotron the "force functions" and the frequencies of the linearized normal and axial betatron oscillations are given as power series in the inverse-square of the number of sectors. The coefficients in these series are expressed either in terms of parameters characterizing the magnetic field or in terms of those specifying the family of equilibrium orbits. The first-order terms agree with those in existing approximate expressions. Among other features of the higher order terms, they show that it is possible to design magnetic fields with momentum compactions varying over wide ranges and frequencies of betatron oscillations remaining constant. Together with a scheme proposed earlier of transferring ions continually between circular accelerators, this opens the possibility of accelerating ions continually in several stages of constant-frequency sectorial cyclotrons to multi-BeV energies. This method of analysis can also be applied to the study of nonlinear betatron oscillations. A.

537.534.74 : 539.185

4463. STUDY OF NEUTRON–PROTON SCATTERING IN PHOTOGRAPHIC PLATES. I. ANGULAR DISTRIBUTION OF RECOIL PROTONS SCATTERED BY 2.33 MeV NEUTRONS. F.Senent, J.Aguilar, M.de la Cuadra and L.Miralles.
An. Real Soc. Espaň. Fís. Quím., Vol. 52(A), No. 11-12, 267-72 (Nov.-Dec., 1956). In Spanish.

Results are in agreement with measurements with other methods and with theoretical predictions. L.Pincherle

537.534.74

4464. THE ELASTIC SCATTERING OF PROTONS BY PROTONS AT 925 MeV. P.J.Duke, W.O.Lock, P.V.March, W.M.Gibson, J.G.McEwen, I.S.Hughes and H.Muirhead.
Phil. Mag. (Eighth Ser.), Vol. 2, 204-14 (Feb., 1957).

Ilford G5 emulsions have been exposed to a 925 MeV beam from the Birmingham proton synchroton. Sixty-five examples of the elastic scattering of protons by free protons in the emulsion have been found in 1539 metres of track. After removal of events having azimuthal angles $\psi > 45^0$, where ψ is the angle between the plane of the two secondary particles and the plane of the emulsion, the remaining 44 events yielded a total elastic cross-section of 17 ± 3 millibarns. The angular distribution of all the events shows a strong forward peak in the centre of mass system. The shape of this distribution has been compared with the predictions of a simple optical model and a value of $(0.9 \pm 0.1) \times 10^{-13}$ cm has been found for the interaction radius of the proton. The results are compared with other experimental work. A.

537.534.74

4465. n–d SCATTERING AT 2.45 AND 3.27 MeV. J.D.Seagrave and L.Cranberg.
Phys. Rev., Vol. 105, No. 6, 1816-20 (March 15, 1957).

Complete angular distributions for the elastic scattering of neutrons by deuterons have been obtained at 2.45 and 3.27 MeV by direct observation of the scattered neutrons using a time-of-flight technique, and results are given with a probable error of less than 3%. No support is found for the strong forward scattering indicated by a previous cloud-chamber experiment. The theoretical predictions of Buckingham, Hubbard and Massey are in closer agreement with this experiment than are those of Christian and Gammel. The n–d scattering is found to be very similar to p–d scattering at the same incident energy. A.

537.534.8

4466. ELASTIC p–p SCATTERING AND PECULIARITIES OF THE π-MESON–NUCLEON INTERACTION. L.M.Soroko.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 699-701 (1956). In Russian.

The maximum in the 90° p–p differential cross-section occurs at just the energy that would be expected if this were due to the reaction of the inelastic cross-section, and if the inelastic scattering (meson production) occurred mainly through isobar states.

G.E.Brown

537.534.9 : 541.183.022

4467. EFFECT OF MONOLAYER ADSORPTION ON THE EJECTION OF ELECTRONS FROM METALS BY IONS. H.D.Hagstrum.
Phys. Rev., Vol. 104, No. 6, 1516-27 (Dec. 15, 1956).

Electron ejection from metals by ions is shown in this work to be a surface-sensitive phenomenon which is profoundly affected by the adsorption of a monolayer of foreign gas on an atomically clean metal surface. Monolayer adsorption is shown to decrease the total electron yield, γ_i, primarily at the expense of the faster electrons ejected from the metal. Measurements of γ_i show it to decrease steadily as the monolayer forms and to level off at a value characteristic of the covered surface when the monolayer is completed. Measurements have been made for the adsorption of N_2, H_2 and CO on tungsten. Electron ejection by all the singly-charged ions of the noble gases has been studied. It was possible to clean the tungsten surface in the presence of N_2 and CO but not in H_2. In H_2 the tungsten surface, as judged from γ_i measurement, was found to be covered with about 75% of a monolayer immediately upon cooling from 2000°K. It is shown that the effect of monolayer adsorption cannot possibly be simply the result of change in work function. There is also evidence that electrons are ejected in non-Auger processes at higher ion energies when the surface is covered. A.

DISCHARGE TUBES. COUNTERS 537.54

537.542 : 621.385.12

4468. NEW GAS-FILLED COLD CATHODE AMPLIFIER TUBE. C.H.Hertz.
Appl. sci. Res. B, Vol. 5, No. 1-4, 176-8 (1955).

Describes a point–plane corona gap in which the plane electrode is provided with slots, in each of which an insulated wire is mounted. The wires act as the anode in an amplifying tube and the negative point as cathode. At a hydrogen pressure of 100-200 mm Hg, the corona gap passes approximately 0.3-0.4 mA at 600-1000 V. An amplification factor of ~ 50 to 100 is obtained. Other data are given.

J.D.Craggs

537.542

4469. AN INVESTIGATION OF MULTIPLE SPURIOUS DISCHARGES IN GM-COUNTERS. E.Friedländer and D.Kiss.
Acta phys. Hungar., Vol. 6, No. 2, 217-23 (1956).

A simple and direct method has been worked out for distinguishing random and systematic "multiplets" in the counting of G.M. pulses. This method has been applied to the study of the dependence of the average multiplicity of a G.M. pulse on the overvoltage. It has been shown that the rise of the plateau of the counting characteristic is due in great part to the increase of the average multiplicity. A.

537.542

4470. A STUDY OF THE OPERATION OF G-M COUNTERS AT LOW TEMPERATURES. S.P.Puri.
Proc. Nat. Inst. Sci. India A, Vol. 22, No. 4, 214-19 (July, 1956).

The operation of two self-quenching G-M counters is analysed at low temperatures by studying the time distribution of pulses by the method of delayed coincidences. The results indicated that: (i) the dead and transit times increase exponentially with the decrease of temperature in case of an argon–petroleum-ether filled counter (No. 1) whereas these are substantially the same in case of argon–butane filled counter (No. 2). (ii) The values of the coefficient of spuriousness due to secondary emission remain constant with temperature. The explanation of the increase in dead and transit times seems to be in the cluster formation at lower temperatures due to a certain degree of saturation of the polyatomic constituent. However, no such effect is expected in case of counter No. 2, since butane (b.p. = −0.5° C) remains unsaturated throughout the range investigated. A.

537.542

4471. THE INFLUENCE OF BROMINE ON THE CURRENT PULSE IN COUNTERS. P.F.Little.
Appl. sci. Res. B, Vol. 5, No. 1-4, 297-301 (1955).

Describes and discusses the effect of bromine vapour on the mean current flowing in an irradiated neon–argon–bromine filled counter tube. J.D.Craggs

537.542

4472. RESOLVING POWER OF SCINTILLATION SPECTROMETERS. I.F.Barchuk, E.M.Galkin, M.V.Pasechnik and N.N.Pucherov.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 19, No. 3, 352-4 (1955). In Russian. English translation in: Atomic Energy Res. Establ. (Harwell) Transl. No. 656, 3 pp. (1956).

The energy resolution of a scintillation counter is studied using two light pulse sources, one a NaI(Tl) phosphor crystal excited by mono-energetic β-rays and the other a tungsten lamp source pulse-modulated by a Kerr cell system. Results confirm the well-known limits to counter resolution viz. phosphor and photocathode efficiencies. G.F.J.Garlick

537.542

4473. ON THE PROPORTIONAL RESPONSE OF LARGE AREA LIQUID SCINTILLATION COUNTER FOR COSMIC RAYS. G.H.Vaze.
J. sci. industr. Res., Vol. 16 B, No. 1, 1-4 (Jan., 1957).

A large-area liquid scintillation counter viewed by two photomultipliers, showing uniform sensitivity and negligible dark current noise background, is described. Its response for cosmic-ray events was investigated by a synchroscopic method. Cosmic-ray events were selected by a suitable G.M. counter assembly forming a coincidence arrangement. Master coincidence pulse from the G.M. counter assembly was used to trigger the synchroscopic circuit, and the time associated output from the liquid scintillation counter displayed on Y-axis was recorded by a camera. The pulse height distribution data obtained by the above method are presented. A.

537.542

4474. THE DESIGN OF A ČERENKOV COUNTER FOR THE PROTON SYNCHROTON AT BIRMINGHAM UNIVERSITY. J.V.Jelley.
Atomic Energy Res. Establ. (Harwell) Rep. NP/R1770, 15 pp. (1955).

The proposed instrument is a development of a design described by Getting (Abstr. 1229/1947). It is adapted for use with a beam featuring a high proton rate on pulse with a low repetition frequency. The radiator is a perspex cone, the detector a photocell. A resolution limit better than ±16% for a 1 BeV, 1 cm diameter beam is anticipated. Provision for rapid interchange of cones for different energies, could be made. E.A.Ash

537.542 : 539.16.08

4475. BURST-SLUG CERENKOV DETECTOR. C.M.Gordon and J.I.Hoover.
Nucleonics, Vol. 15, No. 1, 91-3 (Jan., 1957).

Cherenkov radiation from high-energy (> 5 MeV) β-rays emitted by fission products was detected from an aqueous solution of uranium nitrate after irradiation in a betatron beam. β's from Br^{87}, I^{136}, Rb^{90}, Y^{94} and the $Kr^{88} \rightarrow Rb^{88}$ chain were identified by their half-lives. It is suggested that this method would be useful as a fission product detector in a water-cooled reactor. No chemical separations are necessary and a high background of β's and γ's can be tolerated. R.D.Smith

537.542

4476. FAST DETECTOR OF HEAVY PARTICLES. W.E.Stein and R.B.Leachman.
Rev. sci. Instrum., Vol. 27, No. 12, 1049-51 (Dec., 1956).

A fast, high-efficiency detector of heavy particles that results in negligible changes in the velocity and direction of the detected particles has been built. The detector consists of an electron accelerator and a scintillator that responds to delta particles emitted by the passage of each particle through a thin foil. For fission fragments, time resolutions of 3×10^{-9} sec, with efficiencies greater than 95%, have been obtained. The fragment velocity loss in traversing the thinnest foils used was less than 1%. A.

537.542 : 621.387

4477. INVESTIGATIONS OF COLD-CATHODE COUNTER-TUBES. W.Rentsch.
Hochfrequenztech. u. ElektAkust., Vol. 65, No. 2, 66-8 (Sept., 1956). In German.

Gives a general description and discussion of cold-cathode gas-filled counter tubes (ring counters). The voltage–current characteristics of certain tubes are shown for gas pressures of 10-25 mm Hg (rare gases). Oscillograms of the pulse voltages are given for input frequencies of 50 and 100 kc/s (output frequencies are $\frac{1}{10}$th of the input frequencies). A typical circuit arrangement is also shown. J.D.Craggs

537.542 : 621.374.32

4478. EXPERIMENTAL INVESTIGATIONS OF THE DEAD TIME OF UNIVIBRATORS. D.Kiss and J.Szivek.
J. sci. Instrum., Vol. 34, No. 3, 99-100 (March, 1957).

In a series of measurements carried out on several types of plate-to-grid-coupled univibrators (mono-stable multivibrators) triggered by negative pulses it was found that the dead time strongly depends on the amplitude of the triggering pulse. It has been proved experimentally that this effect leads to time lags if the univibrator is triggered by pulses of a Geiger–Müller counter. A.

537.542

4479. A SOFT VALVE SCALER FOR INTERMITTENT FAST COUNTING. G.W.Hutchinson.
J. sci. Instrum., Vol. 34, No. 3, 109-10 (March, 1957).

A simple scaling circuit is described in which gas-filled scaling valves are used for counting bursts of radiation without severe counting losses, even when the mean interval between counts within the bursts is much less than the resolving time of the soft valves. To do this, information is stored during the bursts as charge on a condenser and is subsequently read off as a series of evenly spaced pulses by discharging the condenser with a standard repetitive waveform. A.

537.542

4480. ELECTRONIC SUBTRACTION OF BACKGROUND WITH A HUTCHINSON–SCARROTT KICKSORTER. C.W.McCutchen.
Phil. Mag. (Eighth Ser.), Vol. 2, 113-18 (Jan., 1957).

A semi-automatic background subtracting system has been developed for the Hutchinson–Scarrott kicksorter. It provides for direct measurement of "live time", i.e. total counting time minus dead time. The statistical implications of background subtraction are discussed. A.

537.542

4481. MAGNETIC RECORDER FOR NUCLEAR PULSES. P.E.Cavanagh and D.A.Boyce.
Rev. sci. Instrum., Vol. 27, No. 12, 1028-33 (Dec., 1956).

A simple reliable process is described for recording the amplitudes of individual pulses on magnetic tape. This enables the pulse analysis to be performed after the experiment, and under optimum conditions. Low counting rates may be recorded with the tape moving slowly, and then speeded up on playback, so that, for example, a twenty-four hour run may occupy only seven minutes analyser time. The recording process is strictly linear over a range of signal/r.m.s. noise of up to 300/1. A maximum rate of 400 pulses per second may be recorded. The resolution varies with pulse amplitude, but, over the upper two-thirds of the linear range the relative spread assumes a very nearly constant value of about 3%. A further development is described in which gated time-coincident pulses are recorded simultaneously on twin tracks of the same tape. In data-gathering power this system is better than an array of thirty conventional thirty-channel pulse analysers. It may also be applied to the simultaneous recording for separate analysis of the outputs of up to about ten independent detectors. A.

537.542 : 621.374.33

4482. LINEAR GATE OF 200 MILLIMICROSECOND DURATION. E.L.Garwin and A.S.Penfold.
Rev. sci. Instrum., Vol. 28, No. 2, 116-19 (Feb., 1957).

An electronic gate circuit is described which has better than 1% linearity for pulses in the range 1 to 70 V. The circuit gives an inverted output with a gain very close to unity and accepts positive inputs. The leakage of a 70 V pulse through the closed gate is 0.6 V and the largest negative-going portion of the gating transient is 0.2 V. The gate can be reliably opened with positive trigger pulses in the range 4-9 V and the time jitter over this range is the same as the rise time of the trigger pulses. The inherent rise time of the gate output is about 50 mμsec. A.

537.542

4483. OPERATION OF A DIFFUSION CLOUD CHAMBER WITH 23 ATM OF DEUTERIUM. A.P.Batson, B.B.Culwick, H.B.Klepp and L.Riddiford.
J. sci. Instrum., Vol. 34, No. 1, 17-19 (Jan., 1957).

The successful operation of an 18 in. diameter cloud-chamber is reported. The importance of the tritium and oxygen content are discussed. An account of the apparatus for the manufacture and transfer of the deuterium is given. A.

537.542

4484. PROBLEM OF THE MECHANISM OF TRIGGERING OF BOILING OF METASTABLE LIQUID SYSTEMS BY IONIZING IRRADIATION. G.A.Askar'yan.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 897-9 (1956). In Russian.

Phenomena are reviewed which occur or might occur in bubble chambers. The argument is presented in qualitative or semi-quantitative terms. Discussion includes formation of bubbles by accumulating positive ions, effect of negative ions being formed, local heating by nuclear collisions and conditions of superheating. R.Eisenschitz

537.543 : 621.385.23

4486. THERMIONIC DIODES AS ENERGY CONVERTERS. H.Moss.
J. Electronics, Vol. 2, No. 4, 305-22 (Jan., 1957).

Power is dissipated in a resistor connected directly between anode and cathode of a thermionic diode when the cathode is raised to operating temperature. A diode is thus a direct heat-to-electricity converter. This paper analyses the conversion phenomena in a planar system and relates power output to the various diode parameters. In particular, it is shown that the limitation on power conversion efficiency brought about by the space charge barrier can be made arbitrarily small by sufficiently reducing the anode to cathode spacing. However, spacings of the order of 0.01 mm are needed to achieve reasonable efficiencies. The paper is of interest in a pedagogical sense, since it throws light on various phenomena in the planar diode, including the effects of cathode and anode work functions. Numerical results are presented which are of general interest in diode theory, and there is a comparison of the exact diode characteristic solution (using η–ξ tables) and the well known Langmuir approximate expansion formula. A.

537.543 : 621.385.2

4487. THE CYLINDRICAL DIODE. D.A.Bell and H.O.Berktay.
J. Electronics, Vol. 2, No. 5, 425-35 (March, 1957).

Formulae for the properties of the cylindrical thermionic diode (cathode inside anode) are reviewed and presented in such a way as to include the plane diode as a limiting case when $r_a/r_c \rightarrow 1$. The properties considered are (i) the current-density which is calculated if one neglects initial velocities; (ii) the corrections in current-density formula to take account of the initial velocities; (iii) the retarding field characteristic; and (iv) the empirical treatment of shot-noise in the space-charge-controlled cylindrical diode. A.

537.542

4485. BUBBLE CHAMBER FOR INVESTIGATION OF COSMIC RAYS. E.V.Kuznetsov, M.F.Lomanov, G.A.Blinov and Khuan Shen-Nyan'.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 911 (1956). In Russian.

The successful construction and operation of the device is reported. The chamber consists of a metallic cylinder (useful volume 1 litre) filled with freon ($CClF_3$) and fitted with two windows

of organic glass. The sensitive volume communicates through a membrane to a "pressure regulator" which is connected to a compression-expansion system operating at 10 c/s. The function of the pressure regulator is to limit both the maximum and the minimum pressure applied to the chamber, within conveniently preset values. The pressure–time curve has the shape of a square wave. In this way the efficiency (i.e. the ratio of sensitive time to total operating time) is of the order of 0.1. This has enabled five pictures of cosmic rays per minute to be obtained. A sectional view of the device and a good picture of cosmic-ray tracks are given. No mention of the operating conditions is made. G.Martelli

IONIZATION. THERMIONICS 537.56/.58

537.561 : 535.345

4488. PHOTOIONIZATION AND TOTAL ABSORPTION CROSS SECTION OF GASES. II. O_2 AND N_2 IN THE REGION 850-1500 A. K.Watanabe and F.F.Marmo.
J. chem. Phys., Vol. 25, No. 5, 965-71 (Nov., 1956).

For Pt I, see Abstr. 11164 (1954). Absorption and photoionization cross-sections of O_2 were measured at a number of wavelengths primarily in the region 850-1100 A by a photoelectric method. The Rydberg bands H, H', M and M' were found to be strongly pre-ionized, and vibrational structures in the underlying continuum appeared to be present. The photoionization method gave 12.08 ± 0.01 eV as the first ionization potential of O_2. This value, combined with data from emission spectra, yielded a value 6.65 eV for the dissociation energy of O_2^+ and 16.83 eV for the third ionization potential of O_2 ($O_2^+ A^2\Pi_u \leftarrow O_2 X^3\Sigma_g^-$). In the case of N_2, a number of "windows" were observed and it was not possible to establish the presence of an absorption continuum in the region 850-1100 A. A.

537.562

4489. ON THE SATURATION CURVES OF Po α-PARTICLES IN CO_2. P.Huber.
Appl. sci. Res. B, Vol. 5, No. 1-4, 340-4 (1955). In German.

It was found that the charge Q produced by a particle of energy E in a gas was given by $1/Q = (1/Q_0)(1 + \text{const}/E)$, where the saturation charge Q_0 was obtained by a linear extrapolation to $1/E = 0$. The gases O_2, A, NH_3, CCl_4, SO_2 and BF_3 gave values of Q_0 independent of pressures. CO_2 however exhibited an anomalous dependence of Q_0 on pressure, both for electron and ion collection. J.Hughes

537.562

4490. FIELDS ON PLASMA IONS BY COLLECTIVE COORDINATES. A.A.Broyles.
Phys. Rev., Vol. 105, No. 2, 347 (Jan. 15, 1957).

A discussion is given of the results of applying an improved method, employing collective coordinates, to the evaluation of the n-dimensional integrals occurring in the problem of determining the probability that a given electric field will appear on an ion in a plasma. A.

537.564

4491. CHARGE EXCHANGE AND IONIZATION CROSS SECTION DETERMINATION FOR POSITIVE IONS AND ATOMS IN THE ENERGY REGION 2.5 TO 25 keV. F.J.de Heer, W.Huizenga and J.Kistemaker.
Appl. sci. Res. B, Vol. 5, No. 1-4, 337-9 (1955).

Ions from an isotope separator, after being magnetically analysed for mass, were passed into an ionization chamber in which the gas pressure could be varied. The cross-sections were determined by a modification of Wien's method. The results for N^+, A^+, N_2^+, Ne^+, H^+, in H_2 are given in tabular form. J.Hughes

537.564

4492. THE INFLUENCE OF ELECTRON ENERGY ON THE DISSOCIATION OF MOLECULES INTO IONS. J.Momigny.
Bull. Soc. Roy. Sci. Liège, Vol. 25, No. 3, 183-95 (March, 1956). In French.

Describes and interprets experiments on the effect of varying the bombarding electron energy in a mass spectrometer on the relative abundances of different ions formed by dissociation of molecules, including Ne, CO, CO_2, CS_2, C_3H_8, C_2H_6 etc. Particular attention is paid to the occurrence of appearance potentials less than the ionization potentials, ascribed to prior excitation of molecules which have diffused into the electron gun. J.Hawgood

537.564

4493. METASTABLE TRANSITIONS AND COLLISION-INDUCED DISSOCIATIONS IN MASS SPECTRA. H.M.Rosenstock and C.E.Melton.
J. chem. Phys., Vol. 26, No. 2, 314-22 (Feb., 1957).

A number of new metastable transitions have been identified in the mass spectra of n-butane and i-butane. The appearance of various metastable transitions was discussed in terms of the quasi-equilibrium theory of mass spectra and the energetics of ionic decomposition processes. A study of the pressure independence of metastable transitions revealed the existence of several collision-induced dissociations. Some similarities of these processes to electron impact induced dissociations were pointed out. Approximate relative cross-sections were determined for the various collision processes. A.

537.564

4494. INELASTIC COLLISIONS BETWEEN HEAVY PARTICLES. V. ELECTRON LOSS FOR FAST He^+ IONS PASSING THROUGH ATOMIC HYDROGEN, AND IONIZATION OF HYDROGEN ATOMS BY FAST He^+ IONS. T.J.M.Boyd, B.L.Moiseiwitsch and A.L.Stewart.
Proc. Phys. Soc. A, Vol. 70, Pt 2, 110-16 (Feb., 1957).

For Pt IV see Abstr. 2829 (1955). Born's approximation is used to calculate the cross-sections for the processes

$$He^+(1s) + H(1s) \rightarrow He^{2+} + e + H(1s, 2\overline{sp}, 3\overline{spd} \text{ or } C),$$

where C represents the continuum. The effect of double transitions is found to be important for impact energies greater than about 300 keV. The agreement between the calculated electron loss cross-section and the experimental data of Allison, Cuevas and Murphy (Abstr. 5953/1956) for energies of the incident He^+ ion lying between 100 and 450 keV is quite good except at the limits of the experimental energy range. The ratio of the electron-loss cross-section to the electron-capture cross-section is also computed and compared with experiment Again, the agreement is quite good. In addition, Born's approximation is employed to calculate the cross-section for the process

$$He^+(1s) + H(1s) \rightarrow He^+(1s) + H^+ + e,$$

which provides the dominant contribution to the total ionization cross-section. A.

537.564

4495. INELASTIC COLLISIONS BETWEEN HEAVY PARTICLES. VI. THE $2s\,^3S-2p$ AND $3p\,^3P$ EXCITATIONS OF FAST He ATOMS BY H AND Ne ATOMS. J.Adler and B.L.Moiseiwitsch.
Proc. Phys. Soc. A, Vol. 70, Pt 2, 117-22 (Feb., 1957).

Born's approximation is used to calculate the cross-sections for the processes

$$He(2s\,^3S) + Ne(2p^6\,^1S) \rightarrow He(2p \text{ or } 3p\,^3P) + Ne(2p^6\,^1S)$$

and

$$He(2s\,^3S) + H(1s) \rightarrow He(2p \text{ or } 3p\,^3P) + H(1s \text{ or } 2\overline{sp}).$$

In addition, the total cross-sections at high energies for the $2s\,^3S-2p$ or $3p\,^3P$ excitations of He atoms by Ne and H atoms are obtained. A.

537.564 : 539.153.4

4496. THE CONVERSION OF METASTABLE HELIUM FROM THE SINGLET TO THE TRIPLET STATE BY ELECTRON COLLISION. R.Marriott.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 288-95 (April, 1957).

The zero-order partial cross-section has been calculated for the conversion of $He^*(2^1S)$ metastable atoms to $He^*(2^3S)$ by super-elastic collision with thermal electrons. A numerical method has been used, which retains all the direct-coupling terms between the initial and final atomic states. Full allowance has been made for electron exchange. A cross-section of 5×10^{-15} cm^2 was obtained at a temperature of 300°K, which is rather too small to account for the experimental value of 3×10^{-14} cm^2 observed by Phelps. A.

537.564

4497. MERCURY VAPOR JET TARGET AND STRIPPER. R.Beringer and W.Rall.
Rev. sci. Instrum., Vol. 28, No. 2, 77-9 (Feb., 1957).

A supersonic mercury vapour jet has been developed for use in stripping electrons from a beam of heavy ions. The required surface densities (2 to 20 μg/cm^2) were obtained with the apparatus described. The increase in pressure caused by the jet was less than 3×10^{-7} mm Hg at the end of a 10 in. beam tube. A.

537.564 : 534.222.2

IONIZATION BY SHOCK WAVES IN ARGON. See Abstr. 4059

537.565

4498. EFFECT OF VARIABLE IONIC MOBILITY ON AMBIPOLAR DIFFUSION. L.S.Frost.
Phys. Rev., Vol. 105, No. 2, 354-56 (Jan. 15, 1957).

Recent measurements of the mobility of atomic rare gas ions in

their parent gases have shown that the mobility falls with increasing field strength, becoming inversely proportional to the square root of the field at high fields. This paper presents the solution to the ambipolar diffusion problem for cylindrical geometry and with the observed field dependence of ionic mobility. Results for He^+ ions in He indicate that ambipolar diffusion in a low-pressure positive column may be reduced by a factor of two or more from that predicted by using constant mobility. The theory is also applicable to Ne^+ ions in Ne and to A^+ ions in A. A.

537.568 : 539.13

4499. CROSS SECTIONS OF DISSOCIATIVE RECOMBINATION. E.Bauer and T.-Y.Wu.
Canad. J. Phys., Vol. 34, No. 12B, 1436-47 (Dec., 1956).

A hydrogen molecular ion H_2^+ in its ground state, $1s\sigma\ ^2\Sigma_g^+$, captures a free electron of low energy and splits up into two hydrogen atoms in the states H(1s) + H(2s) or H(1s) + H(2p). The cross-sections for transitions into these two states are calculated in a "Born approximation" as functions of electron energy for energies less than 1 eV, and are found to be of gas kinetic order of magnitude (10^{-15} cm^2). A.

537.568

4500. COLUMNAR RECOMBINATION IN NITROGEN. E.H.Bellamy and W.R.Hogg.
Phil. Mag. (Eighth Ser.), Vol. 1, 722-4 (Aug., 1956).

Using pure N_2 in a pulse ionization chamber, three Po α-ray sources were mounted at different distances from the collector, each removable under operating conditions and with voltages adjusted to give full electron-collection at low pressures. At 10 atm, pulse heights from all sources had decreased and to the same value, a loss due to either preferential or columnar recombination between electrons and positive ions. The latter is shown to be the likely process since at 20 atm, no pulses from Po α-particles were observed but pulses from strong secondary electron (Co^{60}) and proton (2.5 MeV neutron) sources showed no loss of height. D.V.Mabbs

537.568

4501. COLLECTION OF IONS PRODUCED BY ALPHA PARTICLES IN AIR. C.Wingate, W.Gross and G.Failla.
Phys. Rev., Vol. 105, No. 3, 929-30 (Feb. 1, 1957).

An investigation of the effects of pressure and collector potential on ion collection in air indicates that recombination of ions may occur even when the ionization current is independent of the collecting field. A Po^{210} source of reduced-range alpha-particles was used as the central electrode in a cylindrical ionization chamber of sufficiently large dimensions that the residual energy of the particles was absorbed by the gas at pressures greater than 4.5 cm of mercury. Apparently complete ion collection was achieved by reducing the pressure until at 10 cm of mercury a maximum ionization current was obtained which was independent of the collecting field and of further reduction in pressure. The ionization current at atmospheric pressure, though independent of the collecting potential over a large range of voltages, was 3.3% lower. Since field independence has been the usual criterion of saturation, undetected recombination is suggested as a possible cause for the apparent increase of average energy expended per ion pair formed in air (W) by alpha-particles of decreasing energy as well as the reported difference between W values for alpha and beta particles. A.

537.568

4502. ELECTRON CAPTURE OF PROTONS PASSING THROUGH HYDROGEN. T.Pradhan.
Phys. Rev., Vol. 105, No. 4, 1250-9 (Feb. 15, 1957).

A formal treatment of the capture problem is presented and a suitable approximation scheme valid for fast collisions is developed. The approximations consists of: (1) using a suitable perturbed initial wave-function instead of the unperturbed initial wave-function used in the Born approximation, (2) neglecting the contribution of "two-step capture processes", and (3) in an impulse approximation fashion, neglecting the effect of the binding of the electron in the atom in the initial state "during" the collision. All the above three approximations result from an attempt to express the transition matrix for capture in terms of two-body operators. The improved wave-function is orthogonal to the final wave-function in the limit of infinitely heavy incident ion, unlike the Born approximation wave-function. Consequently the (incident ion)—(nucleus) interation has zero matrix element for transition from the initial state to the final state. Only the (incident ion)—(electron) interaction contributes to the capture cross-section in this approximation. Good agreement with experiment is obtained in the particular case of protons picking up electrons from hydrogen gas for proton energies above 25 keV. A.

537.583 : 621.385.032.21

4503. PROPERTIES OF AN INDIRECTLY HEATED COLD CATHODE IN LOW-PRESSURE PULSE DISCHARGES. É.M.Reĭkhrudel', A.G.Zimelev and A.V.Kustova.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 20, No. 10, 1153-61 (1956). In Russian.

Microscopical observation of the cathode surface, oscillograms of currents and voltages in the space between the heating electrode and the cathode and in the main discharge, and measurement of the X-ray focus on the anode surface were the three methods used in the investigation of pulse discharges at 3-100 kV and 10^{-2}-10^{-6} mm Hg. The currents were of the order 1 kA, the current densities up to 10^6 A/cm^2. The arrangement was found to be satisfactory for pulse equipment. Electrical Research Association

537.583 : 621.385.032.216

4504. INFLUENCE OF THE CATHODE BASE ON THE CHEMICAL ACTIVATION OF OXIDE CATHODES. R.W.Peterson, D.E.Anderson and W.G.Shepherd.
J. appl. Phys., Vol. 28, No. 1, 22-33 (Jan., 1957).

By the use of radioactive tracer techniques it is shown that the strontium evolution from an oxide-coated cathode provides a measure of the rate of reduction of the coating. For the cases of carbon, aluminium, manganese, and tungsten the results indicate that the rate of reduction of the coating is controlled by diffusion of the reducing agents from the base nickel. The rate at which common reducing agents (excluding carbon) reach the nickel-coating interface is proportional to $t^{-1/2}$ for lifetimes up to 10^4 hours. For oxide-coated cathodes operated without current drain the thermionic emission as measured by pulse means is observed to correlate with the rate of reduction of the coating. The development of thermionic activity can be understood in terms of a model in which the concentration of donors in the oxide particles is controlled by the surface concentration of the alkaline earth metals. This surface concentration is controlled by the rate of reduction of the coating, with the further postulate that there is a maximum effective surface concentration. A.

537.583 : 621.385.032.213.13

4505. ON THE RELEASE OF ALKALINE EARTH METALS BY THE ELECTRON DISSOCIATION OF OXIDE FILMS EVAPORATED FROM THE OXIDE-COATED CATHODES. T.Imai and I.Mitsufuji.
J. Phys. Soc. Japan, Vol. 12, No. 1, 105-6 (Jan., 1957).

The glow discharge observed in the anode—cathode space is measured and related to gas pressure in the system. The glow is examined spectroscopically and lines due to Ba, Sr, and Ca are observed. The glow is not due to the increase in gas pressure but to localized Ba, Sr, Ca vapours which are left initially on the electron-bombarded anode and then released by sublimation. C.A.Hogarth

537.585

4506. SURFACE IONIZATION OF MOLECULES OF POTASSIUM CHLORIDE AND CAESIUM CHLORIDE IN AN ELECTRIC FIELD. N.I.Ionov.
Zh. tekh. Fiz., Vol. 26, No. 10, 2200-3 (1956). In Russian.

An increasing electric field displaces the temperature threshold of appearence of positive ions during surface ionization of KCl and CsCl to lower temperatures. In the field of the order of 10^7 V/cm a perceptible current of ions is observed at the temperature of the ionizing surface of 50°C. A possible explanation of the phenomenon is given. Z.Krasucki

COSMIC RAYS 537.591

537.591.1

4507. ON THE PRODUCTION OF PENETRATING PARTICLES BY NON-IONISING COSMIC RAYS. G.Bozóki, E.Fenyves and L.Jánossy.
Acta phys. Hungar., Vol. 6, No. 2, 319-24 (1956).

New measurements of the penetrating non-ionizing component of cosmic rays are reported. The effect of anticoincidence counters used to shield the arrangement from sides is found to consist in a decrease of the background only. Experimental results of Roy and Chakravarti are discussed critically. A.

537.591.1

4508. ON THE PHOTON COMPONENT OF EXTENSIVE AIR SHOWERS. L.Jánossy, T.Sándor and A.Somogyi.
Acta phys. Hungar., Vol. 6, No. 3-4, 455-65 (1957).

Extensive air shower measurements carried out simultaneously

with counter batteries of different areas are reported. All the four counter batteries were covered with absorbers of different materials and thicknesses. The spectrum of the effective density (i.e. that of the primaries capable of producing at least one ionizing secondary beneath the absorber) turns out to vary with the material and thickness of the absorber. This means that the transition effect appreciably depends on the nature of showers selected with different counter areas. A.

537.591.1

4509. THE LOW ENERGY END OF THE COSMIC RAY SPECTRUM OF ALPHA-PARTICLES. P.H.Fowler, C.J.Waddington, P.S.Freier, J.Naugle and E.P.Ney.
Phil. Mag. (Eighth Ser.), Vol. 2, 157-75 (Feb., 1957).

An experiment has been carried out at Saskatoon, Canada, at a nominal geomagnetic latitude of 60.5°N, which shows the form of the low-energy end of the cosmic-ray alpha-particle spectrum independent of the earth's magnetic field. The differential spectrum shows a maximum at about 300 MeV per nucleon. The number of particles on the low energy side of the maximum is too great to be accounted for by secondary production, and it is believed that this spectrum represents the differential spectrum of primary alpha-particles outside the earth's magnetic field. A re-analysis of previous experiments at a lower geomagnetic latitude, 55°N, in the American continent, gives a spectrum very similar to the one obtained in Saskatoon. As a consequence of this it appears that the cut-off energies experienced by cosmic-ray particles over the American continent are probably lower than those predicted by geomagnetic theory. A.

537.591.1 : 539.166

4510. LOW-ENERGY GAMMA-RAY SPECTRUM OF COSMIC RADIATION. M.Ageno, G.Cortellessa and R.Querzoli.
R.C. Ist. Super. Sanità, Vol. 19, Pt 11, 933-53 (1956). In Italian.

The energy spectrum of the ultra-soft component of cosmic radiation was studied with a single-channel scintillation spectrometer with one sodium iodide crystal in the open air (at sea level) and below about 100 g/cm^{-2}. It was found that this component consists substantially of secondary photons, the majority of which have an energy of between 50 and 200 keV. The band has a very well-defined maximum at about 80 keV in the open air and about 90 keV below 100 g/cm^{-2}. The incident intensity in the open air was roughly estimated at 100 quanta per min per cm^2 sterad. about the vertical. On the hypothesis (which is true as a first approximation) that the incident radiation is isotropic, this corresponds to an energy flux of about 1% of the total cosmic radiation energy incident on the surface of the earth. The discontinuity of absorption on both sides of the K-limit in lead absorption measurements confirms the photon nature of the ultra-soft component. A.

537.591.15

4511. EXPERIMENTS ON THE ROSSI CURVE. L.Jánossy and L.Nagy.
Acta phys. Hungar., Vol. 6, No. 3-4, 467-84 (1957).

By means of an anticoincidence arrangement showers initiated by ionizing particles and by photons in lead were separated. The maximum rate of showers due to photons was found at a thickness of absorber greater by (0.6±0.09) cm than the absorber thickness at which the maximum rate of showers produced by ionizing particles was recorded. Through a modification of the apparatus it was made possible to separate photon, electron and μ-meson produced showers. G.M.-counters of large surface placed besides the absorber and connected in anticoincidence prevented registration when air showers of great density accompanied the particle generating the shower. The shift of the maxima between the transition curves for photons and electrons was found to be (0.4±0.08) cm. For the ratio of maxima of the above two curves a value of $f/e = 0.41 \pm 0.008$ was obtained as a lower limit. A.

537.591.15

4512. A STUDY OF THE NUCLEAR INTERACTING COMPONENT OF EXTENSIVE AIR SHOWERS OF COSMIC RADIATION. S.I.Nikol'skiĭ, Yu.N.Vavilov and V.V.Batov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 1, 71-3 (1956). In Russian.

A counter hodoscope was operated at 3860 m above sea-level. The variation of density of nuclear interacting particles with distance, r, from the shower axis is approximately $r^{1.4 \pm 0.1}$. The number of such particles as a function of primary shower energy, E, varies as $E^{+0.2}$ below, and as E^{+1} above 10^{15} eV. W.O.Lock

537.591.15 : 539.172.13

4513. OBSERVATION OF THE HIGH-ENERGY PROTON–PROTON COLLISION IN PHOTOGRAPHIC EMULSION. S.Kaneko, O.Kusumoto and S.Matsumoto.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1129-35 (Nov., 1956).

The tracing-back method has been applied to the detection of showers which could be regarded as those produced by single nucleon–nucleon collisions in a stack of stripped emulsions exposed at the stratosphere. The method consists in tracing star-producing tracks back along their passage through successive emulsion strips and in finding primary interactions. It made possible to detect the interactions without any bias irrespective of the number of accompanying evaporation prongs. A shower of the type 1 + 5p detected by this method in a preliminary observation was analysed in terms of the single proton–proton collision. By the assumption of balance of transverse momenta for the charged outgoing particles alone, the incoming proton energy was estimated to be about 25 GeV and the inelasticity to be about 0.4. In this paper these results and other possible estimates have been presented together with a brief description of some features of the shower. A.

537.591.15

4514. EVALUATION OF CASCADE ANGULAR AND RADIAL DISTRIBUTIONS FROM THEIR MOMENTS. B.A.Chartres.
Phys. Rev., Vol. 105, No. 2, 707-13 (Jan. 15, 1957).

The amount of information contained in the moments of the angular and radial distribution functions of an electron–photon cascade is investigated. Methods of reconstructing the distribution functions from their moments are analysed. It is shown that under the Landau approximation the moments determine accurately the angular distribution for all values of $E\theta/E_S$ greater than 0.5, and the radial distribution for all values of Er/E_S greater than 3. A.

537.591.15

4515. COSMIC-RAY BURSTS UNDER LEAD AT SEA LEVEL. H.Carmichael and J.F.Steljes.
Phys. Rev., Vol. 105, No. 5, 1626-35 (March 1, 1957).

The integral size-frequency distributions of ionization bursts near sea level were measured in a thin-walled ($\frac{1}{16}$ in. steel), 8 in. diameter, spherical ion-chamber filled with argon at 50 atm pressure, under 14 different thicknesses of lead ranging from 0.11 cm to 22 cm. The measurements, along with those already published for the ion chamber with no shield and with a 27 cm lead shield, represent some 15 000 hours of recording. The range of size covered extends from about 3×10^4 to 10^8 ion pairs. In a subsidiary experiment the size-frequency distributions of bursts directly associated with extensive air showers were measured and to these were added, at each thickness of the shield, the bursts due to single μ-mesons, protons, and stars derived from the analysis already published. These totals were then subtracted from the gross size-frequency distributions. The bursts remaining are almost wholly due to the electrons and photons of the soft component and to the radiative and knock-on process of μ mesons. Transition curves of these bursts (Rossi curves) are given for selected sizes, corresponding (on the average) to showers of 1, 2, 4, 8, ..., 512 electrons crossing the ion chamber. There is no sign of a second maximum in these transition curves. There is strong evidence that the cascades which give rise to the "first" maximum originate from single electrons or photons incident on the lead shield and hence these experimental results are suitable for a straightforward comparison with cascade theory in an energy range extending to some 50 BeV. Indications of a transition effect of the bursts attributed to stars are noted. A.

537.591.2

4516. THE MEAN VELOCITY OF THE HARD COMPONENT OF THE COSMIC RADIATION AT SEA LEVEL. E.Bagge and R.Thielert.
Naturwissenschaften, Vol. 43, No. 16, 370 (1956). In German.

This has been determined by means of two spark counters in coincidence. The vertical distances between them were 35 and then 248 cm with a 10 cm thick lead absorber above the lower counter. It is found that $v = (1.08 \pm 0.12)\ c$, where c is the velocity of light. E.W Kellermann

537.591.3

4517. IMPACT ZONES FOR SOLAR COSMIC-RAY PARTICLES. R.Lüst.
Phys. Rev., Vol. 105, No. 6, 1827-39 (March 15, 1957).

Orbits for cosmic-ray particles starting from the vicinity of the sun and passing through the geomagnetic dipole field were integrated by using the AVIDAC computer at the Argonne National Laboratory. The methods for integration used in Chicago and Göttingen

were compared. Counting rates at the top of the atmosphere were calculated from the integrated orbits in order to make possible the analysis of cosmic-ray intensity increases during solar flares. Different source widths and declinations were assumed. The calculated counting rates are based on a flat rigidity spectrum at the source. This investigation shows that: (a) distinctive impact zones exist even for large source widths; (b) the position of these zones and the counting rates within these zones depend strongly upon the declination of the source; (c) the earth's magnetic field produces a focusing effect especially at higher latitudes. A.

537.591.5

4518. ON THE PHASE AND THE AMPLITUDE OF COSMIC RAY DIURNAL VARIATION. B.Stensland.
Ark. Fys., Vol. 11, Paper 15, 253-8 (1956).

The diurnal variation in cosmic ray intensity has been measured at the geophysical station in Kiruna (68°N, 20°E and 65° geomag.lat.) with a Geiger-Müller counter set comprising three counter-telescopes, one pointing to the zenith and two pointing east and west respectively with zenith angles of 30°. It appears that the phase and amplitude of cosmic-ray intensity variation has varied during the period 1 January 1954 to 23 March 1955. The registrations also indicate that the average momentum of cosmic-rays is about 3×10^{10} eV/c. The original direction of cosmic-rays before being deflected in the magnetic field of the earth has been constructed for the three directions of zenith, west and east, keeping in mind the fact that the momentum varies. A.

537.591.8 : 551.594.14

4519. RADIOACTIVE SULPHUR PRODUCED BY COSMIC RAYS IN RAIN WATER. P.S.Goel.
Nature (London), Vol. 178, 1458-9 (Dec. 29, 1956).

Rain water samples from places far distant from the sea and with little industrial pollution have been found to contain sulphur which has been identified by its β-activity as S^{35}. The mean concentration found of 1.9 disintegrations/min per litre can be expected if the isotope is produced by cosmic radiation in atmospheric argon. The possibility that some of the activity is due to S^{35} produced by nuclear explosions cannot be ruled out. E.W.Kellermann

537.591.8

4520. INVESTIGATION OF THE IONIZATION SPECTRA OF COSMIC-RAY PARTICLES AT AN ALTITUDE OF 3250 m ABOVE SEA-LEVEL. A.G.Meshkovskiĭ and L.I.Sokolov.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 752-5 (1956). In Russian.

The technique described in an earlier paper (Abstr. 8268/1956) was employed to investigate the ionization spectrum in various particle ranges of the hard and soft cosmic-ray components at an altitude of 3250 m above sea-level. The proton spectrum in the 0.36-1.0 BeV/c interval has been obtained. A.

MAGNETISM 538

538.082 : 536.48

4521. PRINCIPLE FOR NULL DETERMINATION OF MAGNETIZATION AND ITS APPLICATION TO CRYOGENIC MEASUREMENTS. A.Arrott and J.E.Goldman.
Rev. sci. Instrum., Vol. 28, No. 2, 99-102 (Feb., 1957).

A principle of measurement of magnetization is described which uses a sample in a uniform magnetic field such that the sample does not affect the uniformity of the field and the sample itself is uniformly magnetized. The measurement is absolute in that it requires only a measurement of a current and dimensions. The method uses a cylindrical specimen on which a small pitch fine wire coil is wound. The proper current through the coil required to restore the uniformity of the field in all space gives a direct measurement of the magnetization. Uniformity of the field is detected by an induction technique. The method is suitable for most magnetic measurements but in the case of strongly ferromagnetic materials and superconductors requires currents in the coil that are too large. This principle has been incorporated in an apparatus for measurements of magnetizations from liquid helium temperatures to room temperature. A.

538.082.74

4522. AN IMPROVED INDUCTANCE METHOD FOR MEASURING SUSCEPTIBILITIES OF SMALL PARAMAGNETIC SPECIMENS AT LOW TEMPERATURES. F.R.McKim and W.P.Wolf.
J. sci. Instrum., Vol. 34, No. 2, 64-7 (Feb., 1957).

An apparatus is described with which the susceptibilities of small paramagnetic specimens can be determined at temperatures between 77 and 1.8°K. The measurements are made in terms of the change of mutual inductance produced by moving a specimen inside a coil system, using a Hartshorn bridge operating at 175 c/s to measure the inductance. The chief advantage of this type of apparatus is its simplicity of operation, since it involves no delicate moving parts. The sensitivity and reproducibility of the apparatus were investigated using a specimen of manganous ammonium sulphate and it was found that susceptibilities of the order of 3×10^{-6} c.g.s. units could be measured to an accuracy of 1%. Sources of error are discussed. A.

538.112 : 536.7

4523. THE INFLUENCE OF BOUNDARY CONDITIONS ON THE ONSAGER–ISING PARTITION FUNCTION FOR THE PLANE SQUARE LATTICE. H.N.V.Temperley.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 192-7 (Feb., 1957).

A formal proof is given that, in the critical region, the predictions of the model are the same whether the atomic magnets are considered to be arranged on a torus, on a cylinder or on a plane. The latter arrangements involve "raw" edges, and are hard to handle by matrix methods, but can be dealt with by a slight modification of Kac and Ward's treatment. The conclusion is not trivial, because critical assemblies are known to be abnormally sensitive to perturbations, and it is in principle possible that, since correlation distances are large, an alteration in the boundary constraints might affect the entire assembly. A.

538.114

4524. APPLICATION OF VARIATIONAL PRINCIPLE TO ISING MODEL OF FERROMAGNETIC. I.A.Kvasnikov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 5, 755-7 (1956). In Russian.

The properties of a ferromagnetic are obtained by a variational principle applied to the statistical sum over N near-neighbour interactions, subject to N fixed conditions imposed by the lattice for this model. J.W.Gardner

538.114

4525. NEW MAGNETIC ANISOTROPY. W.H.Meiklejohn and C.P.Bean.
Phys. Rev., Vol. 105, No. 3, 904-13 (Feb. 1, 1957).

A new type of magnetic anisotropy has been discovered which is best described as an exchange anisotropy. This anistropy is the result of an interaction between an antiferromagnetic material and a ferromagnetic material. The material that exhibits this exchange anisotropy is a compact of fine particles of cobalt with a cobaltous oxide shell. The effect occurs only below the Néel temperature of the antiferromagnetic material, which is essentially room temperature for the cobaltous oxide. An exchange torque is inferred to exist between the metal and oxide which has a maximum value at 77°K of ~ 2 dyne-cm/cm^2 of interface. A.

538.114

4526. EFFECT OF A CAVITY ON A SINGLE-DOMAIN MAGNETIC PARTICLE. W.F.Brown, Jr and A.H.Morrish.
Phys. Rev., Vol. 105, No. 4, 1198-201 (Feb. 15, 1957).

It has been suggested that the observed low coercive forces of some ferromagnetic powders, as compared with predictions of single-domain-particle theory, may be due to cavities in the particles. Here this possibility is investigated theoretically. Some general formulae are established for a particle of arbitrary shape and for an ellipsoidal particle containing an ellipsoidal cavity; attention is then turned to the case in which both ellipsoids are spheroids, the particle prolate, the cavity either prolate or oblate. Several special cases are studied. In some cases the cavity increases the coercive force, in others it decreases it; for an originally large coercive force, the usual effect is a decrease. It is concluded that the proposed mechanism is capable of accounting, at least in part, for the observed decrease. A.

538.114

4527. FERROMAGNETIC RELAXATION BY THE EXCHANGE INTERACTION BETWEEN FERROMAGNETIC ELECTRONS AND CONDUCTION ELECTRONS. A.H.Mitchell.
Phys. Rev., Vol. 105, No. 5, 1439-44 (March 1, 1957).

The Hamiltonian for the exchange interaction between the ferromagnetic d electrons and the conduction s electrons is derived. The ferromagnetic relaxation time caused by the s–d exchange interaction is calculated in a spin-wave approximation. When one uses a screened value of the exchange integral ($J_{atomic}/30$), the calculated relaxation time for nickel at room temperature is 5×10^{-9} sec as

compared to the time 2.5×10^{-10} sec needed to account for the experimental line width. The exchange relaxation may be dominant in materials such as alloys which have narrower lines than nickel. A.

538.114 : 539.185

ON THE MULTIPLE SPIN WAVE SCATTERING OF NEUTRONS IN FERROMAGNETS. See Abstr. 3738

538.122

4528. CORRECTION TO THE MAGNETIC FIELD DISTRIBUTION FOR AN ELLIPSOID. G.O.McClurg.
Amer. J. Phys., Vol. 25, No. 4, 266 (April, 1957).
See Abstr. 3433 (1957).

538.2 : 621.318.12

4529. MAGNETIC SPECTRA. J.B.Birks.
Proc. Instn Elect. Engrs, Paper 2217R, publ. Oct., 1956 (Part B Suppl. No. 5, 179-88, 213-15).
Republication, with discussion, of the paper abstracted in Abstr. 8861 (1956).

538.22.08

4530. THE MEASUREMENT OF THE MAGNETIC CHARACTERISTICS OF ROCKS. (UNIVERSAL TORSION MAGNETOMETER METHOD). A.G.Kalashnikov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 5, 776-9 (1956). In Russian.
A cubical specimen of the rock is placed on one arm of a torsion balance. Two pairs of coils with their planes vertical and parallel to the balance arm, are set up on opposite sides of the specimen. Current supplies to the two pairs of coils are independent of one another, one pair is arranged as a Helmholtz uniform field arrangement and the other pair is used to provide a linearly variable field. The apparatus allows the magnetic susceptibility, residual magnetization and coercive force of the specimen to be determined for fields ranging from 0.5 to 5 oersteds. The theory of the instrument is given. C.R.S.Manders

538.22 : 548.7

4531. ON THE MAGNETIC MOMENT AND g-VALUE OF COMPLEX IONS. H.Kamimura.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1171-81 (Nov., 1956).
Magnetic properties of complex salts containing paramagnetic ions of transition elements are studied on the crystalline field model. Strong cubic crystalline field splits d-orbital into $d\gamma$ and $d\epsilon$, and the magnetism is due to incomplete $d\epsilon$ shells. The crystalline field is assumed to have, besides cubic part, a component of tetragonal or trigonal symmetry, comparable in magnitude with spin–orbit interaction. Energy level structures, g-values of the ground state and magnetic susceptibilities are calculated for $(d\epsilon)^n$ configurations for $1 \leq n \leq 5$. The effective numbers of Bohr magnetrons, which measure the magnetic susceptibility, are obtained as explicit functions of two parameters $x = \overline{r^2}A/7kT$ and $y = \lambda/2kT$, where A is the coefficient of tetragonal or trigonal field, and λ the constant of spin–orbit coupling. The result is applied to the discussion of magnetic properties of $K_3Fe(CN)_6$ and $K_3Mn(CN)_6$. In an appendix it is shown that the result for the field of trigonal symmetry becomes equivalent to that for the field of tetragonal symmetry. A.

538.221

4532. TEMPERATURE DEPENDENCE OF THE DIFFERENTIAL SUSCEPTIBILITY OF COBALT IN STRONG MAGNETIC FIELDS. L.Pál and T.Tarnóczi.
Acta phys. Hungar., Vol. 6, No. 2, 225-36 (1956).
A curve showing a characteristic double maximum was obtained for the temperature dependence of the differential susceptibility of cobalt in strong magnetic fields; all sections of this curve could be interpreted on the basis of the theory of the rotation processes. The temperature of the minimum between the two maxima calculated from Sucksmith and Thomson's (Abstr. 10323/1954) measurement on monocrystals is found to be in good agreement with the temperature of the experimentally determined minimum of the differential susceptibility of a polycrystalline sample. The effect of the $\alpha \rightleftharpoons \beta$ phase transformation on the differential susceptibility is studied. A.

538.221

4533. ON THE PROBLEM OF THE INTERNAL EFFECTIVE FIELD FOR FERROMAGNETIC RESONANCE OF POLYCRYSTALLINE FERRITES. S.Krupička.
Czech. J. Phys., Vol. 6, No. 5, 458-67 (Oct., 1956).
A study was made of the ferromagnetic resonance of MnZn ferrite in the temperature region -124° to $+182^\circ$C in the 3 cm band. The additional internal effective field and its temperature dependence was determined. A comparison with the results of measurements of the initial permeability carried out at the same time pointed to the close relationship between magnetocrystalline anisotropy and the additional field or apparent value of the Landé factor g^*. A.

538.221 : 621.318.12

4534. INVESTIGATION OF THE PARAMETERS OF FERRITES. L.K.Mikhailovskiĭ.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 20, No. 11, 1279-83 (1956). In Russian.
The possibility of the coexistence in a limited volume of a transversely magnetized gyromagnetic substance of two wave types, one depending on, the other practically independent of, the applied magnetic field is predicted theoretically and confirmed experimentally. A method of practical application of the phenomenon of volume resonance is also presented. Electrical Research Association

538.221

4535. EFFECT OF INHOMOGENEOUS DEMAGNETIZING FIELDS ON FERROMAGNETIC RESONANCE. A.I.Pil'shchikov.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 20, No. 11, 1284-98 (1956). In Russian.
Inhomogeneous demagnetizing fields cause considerable distortions of the curves of resonance absorption and dispersion, particularly a marked expansion of the curves on the side of strong fields. With increasing demagnetizing fields the range of variation of permeability is considerably restricted and the relaxation frequency rises. The separation factor g is practically independent of the demagnetizing factor of the specimen.
Electrical Research Association

538.221

4536. FERROMAGNETIC RESONANCE IN INHOMOGENEOUS CONDITIONS. A.I.Pil'shchikov, Z.D.Trishina and T.A.Zvereva.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 20, No. 11, 1299-309 (1956). In Russian.
The inhomogeneous conditions of ferromagnetic resonance in polycrystalline specimens of ferromagnetic alloys are due to the differences in the orientation of the crystallographic axes of the crystallites with respect to external field, to internal demagnetizing fields and to inhomogeneous internal residual stresses. An experimental investigation of the ferromagnetic resonance effects in various types of permalloy specimens is presented and discussed on the basis of the theoretical considerations in a previous paper (see preceding abstract). Electrical Research Association

538.221 : 621.318.12

4537. EFFECTS OF SIZE ON THE MICROWAVE PROPERTIES OF FERRITE RODS, DISKS, AND SPHERES. J.O.Artman.
J. appl. Phys., Vol. 28, No. 1, 92-8 (Jan., 1957).
The effects of sample size on the apparent properties of ferrites observed by microwave cavity perturbation methods are treated. Retardation effects associated with the propagation of electromagnetic waves in the specimen are considered. Results are given for the idealized cases of rods of infinite length and disks of infinite extent. Methods of adaptation to finite rods and disks are suggested. An approximate solution is given for the sphere which is in qualitative agreement with some aspects of the experimental observations. A formula relating the shift in resonance field to the sphere size is presented:

$$H_R - H_0 = 4\pi M\epsilon\,(16\pi^2/45)(R/\lambda)^2.$$

A.

538.221

4538. ON THERMOMAGNETIC BEHAVIOUR OF CoO–MgO AND CoO–NiO SYSTEMS. N.Perkis and A.Serres.
J. Phys. Radium, Vol. 18, No. 1, 47-50 (Jan., 1957). In French.
Magnetic susceptibility measurement on 3CoO + 2MgO, 2CoO + MgO and 2CoO + NiO, made by the Faraday method, in the temperature range 80-900°K, are reported. The thermomagnetic analysis, in agreement with X-ray powder photographs, show that the samples investigated, prepared at very high temperature, are homogeneous solid solutions. The data fit a Curie–Weiss law $\chi_M = C/(T - \Theta)$ with $C = 3.25$, within 1% the Curie constant found by Elliott for the system CoO–MgO, and a Néel condition $\Theta \cong T_C$. A.

538.221 : 621.318.12

4539. LOW LOSS MAGNESIUM MANGANESE FERRITES. L.C.F.Blackman.
J. Electronics, Vol. 2, No. 5, 451-6 (March, 1957).
The preparation, by the method of thermal decomposition of mixed nitrates, of a Mg–Mn ferrite of low microwave energy loss at Q-band is described. From an observation of the time constant of a toroidal ring of the material, a quick check on the loss is available. A.

538.221

4540. FERRIMAGNETIC RESONANCE IN YTTRIUM IRON GARNET. J.F.Dillon,Jr.
Phys. Rev., Vol. 105, No. 2, 759-60 (Jan. 15, 1957).

Reports results of experiments on a single crystal of $Y_3Fe_2(FeO_4)_3$ at frequencies 9.3 and 24.0 kMc/s and at temperatures between 3° and 540°K. The resonance line width is anisotropic, reaches a peak value between 20° and 65°K and very low values at high temperatures (8 oersted at 540°K in the [100] direction). Values of K_1 and g were also obtained. E.P.Wohlfarth

538.221 : 621.318.12

4541. THE PHYSICAL AND CHEMICAL PROPERTIES OF SOME NICKEL–ZINC FERRITE COMPOUNDS. N.C.Tombs and J.Watkins.
Proc. Instn Elect. Engrs, Paper 2235R, publ. Oct., 1956 (Part B Suppl. No. 5, 141-4, 174-8).

Republication, with discussion, of the paper abstracted in Abstr. 1445 (1957).

538.221 : 548.7 : 621.318.132

4542. EFFECT OF MAGNETOCRYSTALLINE ANISOTROPY ON THE MAGNETIC SPECTRA OF Mg-Fe FERRITES. G.T.Rado, V.J.Folen and W.H.Emerson.
Proc. Instn Elect. Engrs, Paper 2174R, publ. Oct., 1956 (Part B Suppl. No. 5, 198-205, 213-15).

Republication, with discussion, of the paper abstracted in Abstr. 8274 (1956).

538.221

4543. ON THE COMPLEX PERMEABILITY OF IRON–NICKEL ALLOYS AT HIGH FREQUENCIES. J.C.Anderson and B.Donovan.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 186-91 (Feb., 1957).

The real and imaginary parts of the complex permeability have been measured for a series of iron–nickel alloys in the frequency range 300-400 Mc/s. The frequency of the internal resonance observable in this region has been investigated as a function of composition and is found to pass through a minimum in the neighbourhood of 70% Ni. The value of the principal anisotropy coefficient is also known to be very small in this region and a qualitative comparison provides additional support for the view that this resonance is attributable to the equivalent magnetic field associated with the anisotropy energy. A.

538.221

4544. THE PROBLEM OF THE MECHANISM OF MAGNETIZATION PROCESSES IN CERTAIN Ni–Zn FERRITES IN VERY WEAK FIELDS. L.A.Fomenko.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1092-3 (1956). In Russian.

The author discusses earlier work on the subject and concludes that the predominating significance of boundary shift processes in Ni–Zn ferrites, baked at not too low temperatures, follows also from his own investigations (Abstr. 5228/1956) of the magnetic spectra of ferrites in the absolute zero and residual magnetization states. C.R.S.Manders

538.222

4545. PRINCIPAL MAGNETIC SUSCEPTIBILITIES OF ANHYDROUS COBALT AND NICKEL CHLORIDES. H.Bizette, C.Terrier and B.Tsaï.
C.R. Acad. Sci. (Paris), Vol. 243, No. 18, 1295-7 (Oct.29, 1956). In French.

Reports results of susceptibility measurements on single crystals of $CoCl_2$ and $NiCl_2$ between 2° and 300°K. For $CoCl_2$ a maximum is observed in both $\chi_\perp$ and $\chi_\parallel$ at 25°K. For $NiCl_2$ the susceptibility maximum lies at a field dependent temperature near 50°K, and there is a minimum at 33°K. The results are discussed in relation to the crystal structure. E.P.Wohlfarth

538.222

4546. EXCHANGE INTERACTION IN CERTAIN PARAMAGNETICS. S.Kh.G.Kashaev.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 3, 362-4 (1956). In Russian.

Two systems of paramagnetic solutions were investigated: (a) MnS–ZnS, and (b) $Mn(NH_4)_2(SO_4)_2 \cdot 6H_2O$–$Zn(NH_4)_2(SO_4)_2 \cdot 6H_2O$. In each case the width (δ) of the paramagnetic resonance curve was plotted against the relative concentration (f) of the first component of each pair. The exchange effect is manifested by a relatively sharp increase in δ up to $f \sim 0.1$, followed by a slow decrease as $f \to 1$. J.W.Gardner

538.222

4547. THE MAGNETIC SUSCEPTIBILITY OF α AND β BRASS. B.G.Childs and J.Penfold.
Phil. Mag. (Eighth Ser.), Vol. 2, 389-403 (March, 1957).

The magnetic susceptibility has been measured at 77° and 300°K of a series of copper–zinc alloys, ranging in composition from 0-47.6 atomic % zinc, and of one silver–cadmium alloy containing 30.5 atomic % cadmium. For the copper–zinc system the absolute susceptibility ranges from -0.085×10^{-6} e.m.u./g for pure copper to -0.191×10^{-6} e.m.u./g for 47.6% zinc. No significant difference was found between the values for a given alloy at the two temperatures of measurement. The significance of the results is discussed in relation to a theory recently proposed by Henry and Rogers (Abstr. 5251/1956). A.

538.24 : 621.318.23.013.2

4548. FIELD HOMOGENEITY AND POLE DISTRIBUTION. J.D.Bjorken and F.Bitter.
Rev. sci. Instrum., Vol. 27, No. 12, 1005-8 (Dec., 1956).

The design of a magnet for producing a uniform field is described. The magnet model used in the calculations is that of cylindrical cores surrounded by rims. The positions of the central pole faces and rims can be adjusted independently. A calculation, based on the assumption that the pole pieces are uniformly magnetized, shows that, for a certain positioning of the cores and rims, the z^2 and z^4 correction terms to H_z can be simultaneously cancelled. Practical limitations to uniformity that result from a slight asymmetry in the geometry and from the effect of nonuniformity in magnetization because of domain structure in the iron also are discussed. A.

538.24 : 621.318.23.013.2

4549. MICROINHOMOGENEITIES IN MAGNETIC FIELDS. H.H.Brown, Jr and F.Bitter.
Rev. sci. Instrum., Vol. 27, No. 12, 1009-12 (Dec., 1956).

Small variations in the fields of magnets, caused by structures or domains in the pole faces, were investigated by moving a small coil in a circular path. It was found that for a given pole face the variations in the field were all about the same size, and decreased exponentially from the pole face. None of the materials tested as pole faces produced strikingly better fields than another. A.

538.245 : 548.7 : 621.318.12

4550. FERROMAGNETIC GRANULAR STRUCTURES. Γ.M.Prache.
Câbles et Transm., Vol. 11, No. 1, 32-65 (Jan., 1957). In French.

The first part shows that in such granular structures, there probably does not exist any systematic wall formation and that it is possible to set up a coherent theory of ferromagnetic phenomena by admitting that the domains are constituted by the grains themselves. The second part deals with gyromagnetic phenomena caused by magneto-mechanical couplings in the atom and the third part with the effects of propagation of electromagnetic waves in the grains. A.

538.245 : 539.374

4551. THE INFLUENCE OF PLASTIC DEFORMATION ON THE BARKHAUSEN EFFECT. K.Wotruba.
Czech. J. Phys., Vol. 6, No. 5, 468-72 (Oct., 1956). In Russian.

Intensity of the Barkhausen effect is investigated on plastically deformed mumetal as well as on nickel, and compared with the course of "Hc" on the same specimens. In mumetal the intensity of the Barkhausen effect increases monotonically with plastic elongation; with nickel it first rapidly decreases, passes through a minimum and then again gradually increases. On the basis of Tebble's theory of the origin of the Barkhausen effect, this behaviour is qualitatively explained by a change in width of the domain through internal stress produced by plastic deformation. A.

538.245

4552. THE MAGNETIZATION CURVES OF THIN IRON FILMS. K.Závěta.
Czech. J. Phys., Vol. 6, No. 5, 473-86 (Oct., 1956).

The magnetization curves of evaporated iron films 125–7870 A thick were measured. A torsion magnetometer was used for the magnetic measurements. In the neighbourhood of 1100 A an anomaly was found in the dependence of the work of magnetization and a quantity which replaces remanence, on the thickness of the film. Decreased density of the film in comparison with the density of bulk metal was found by weighing. A.

538.245 : 538.652

4553. THE MEASUREMENT OF MAGNETOSTRICTION BY MEANS OF STRAIN GAUGE. H.Takaki and T.Tsuji.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1153-7 (Nov., 1956).

For the purpose of studying the relation of magnetostriction to technical magnetization, a strain gauge was used to measure the

magnetostriction of long-rod single crystals of 3.2% Si-steel, and the results were compared with those obtained on the same samples by using a mechano-optical lever. The latter method was applied in measuring the overall elongation of a rod sample, while the strain gauge recorded the local magnetostriction. In some of the samples, these two methods often gave remarkable difference in the results. This is mainly due to the fact that the sample is not uniformly magnetized, especially in lower magnetic field; the magnetostriction measured by the optical lever method showed only the mean change of length even if the magnetization is not uniform, while the result obtained by the strain gauge corresponds rather well to the local magnetization. The latter method is, therefore, more appropriate for relating the magnetostriction to the magnetization. The magnetostriction constants were determined and found to be slightly different from previous results. A.

538.245

4554. EFFECT OF THE INTERACTION BETWEEN MAGNETIC PARTICLES ON THE CRITICAL SINGLE-DOMAIN SIZE.
A.H.Morrish and L.A.K.Watt.
Phys. Rev., Vol. 105, No. 5, 1476-8 (March 1, 1957).

On theoretical grounds, the critical single-domain size of a ferromagnetic particle is expected to be influenced by the interaction of other neighbouring particles. Measurements of the coercive force of some γ-Fe_2O_3 powders containing particles of different sizes and shapes at various concentrations provide experimental evidence for the existence of such an effect. A.

538.245

4555. CRITERION FOR UNIFORM MICROMAGNETIZATION.
W.F.Brown, Jr.
Phys. Rev., Vol. 105, No. 5, 1479-82 (March 1, 1957).

Current theories of "single-domain" ferromagnetic particles compare the free energy in a state of uniform magnetization with that in an arbitrarily chosen state of nonuniform magnetization. In this paper, the comparison is made between an initial uniform state and all neighbouring states, uniform or nonuniform, as an initially large applied field decreases. The initial state becomes unstable when, for some choice of the varied magnetization, the second variation of the free energy changes from positive to negative. This instability criterion leads to a boundary-value problem; the relative magnitudes of certain eigenvalues determine whether the deviation from the initial state occurs by uniform rotation or by development of nonuniform magnetization. Formulae for the critical radius are found in simple cases; they agree, except for a numerical factor, with formulae of Kondorskii. A.

538.245 : 548.7

4556. SURFACE STRUCTURES AND FERROMAGNETIC DOMAIN SIZES. D.H.Martin.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 77-84 (Jan., 1957).

Studies of the domain structures in the surface layers of crystals of iron and silicon–iron having (111) and (h01) type faces, have permitted calculations to be made of the optimum domain sizes in iron crystals as dependent on the crystallographic orientations of their faces and on their sizes. A.

538.27 : 538.65

4557. NEW EXPERIMENTS ON THE MAGNETOMECHANICAL PHENOMENON. K.Míšek.
Czech. J. Phys., Vol. 6, No. 4, 330-40 (Aug., 1956).

A description is given of new experiments on magnetomechanical effect, observed on torsionally oscillating specimens on a number of ferromagnetic materials and additional data are given for nickel. The question is discussed whether irreversible magnetic processes fundamentally influence the origin of the observed internal friction peak. A.

538.27 : 536.48

4558. THE DE HAAS–VAN ALPHEN EFFECT IN ALUMINIUM.
E.M.Gunnersen.
Phil. Trans. A., Vol. 249, No. 965, 299-320 (1957).

The de Haas–van Alphen effect in aluminium has been studied by measuring the oscillatory variation with magnetic field of the torque on a single crystal at liquid-helium temperatures in fields up to 15.4 kG. The torques were measured by an electronic feedback device designed to reduce the twisting motion of the crystal during torque measurement. Particular attention was paid to the variation of the periods of the relatively high-frequency components of the oscillations with the orientation of the field relative to the crystal axes. A consistent interpretation was obtained by supposing that there are three such periodic components for each field direction, though often the relative amplitude of one or two of these is negligibly small. In terms of Onsager's theory, the period is inversely proportional to the maximum area of cross-section of the Fermi surface by planes normal to the field, and the three periodic components have been shown to correspond to three identical cushion-shaped pieces of the Fermi surface with their principal axes mutually perpendicular. The location of these pieces in relation to the Brillouin zone is discussed and the characteristic dimensions of each piece have been calculated. Some results on the variation of the period of the relatively low-frequency component with field orientation in a (100) plane are described, but no detailed interpretation in terms of the shape of appropriate parts of the Fermi surface has been obtained. A few results on the variation of the oscillation amplitude with field orientation and on the temperature-dependence of amplitude are also presented. Alloying the aluminium with up to 0.26% magnesium increases the period of the low-frequency component by about 2.3%; this suggests that this component arises from electrons rather than holes. The period of the high-frequency component is not significantly changed by alloying. A.

ELECTROMAGNETISM. ELECTRODYNAMICS 538.3/.5

538.3 : 533.6.011

4559. ENERGY EQUATION OF MAGNETO-GAS DYNAMICS.
S.-I.Pai.
Phys. Rev., Vol. 105, No. 5, 1424-6 (March 1, 1957).

The general energy equation of a viscous, heat-conducting, and electrical-conducting fluid in magneto-gas-dynamics has been derived. Various simplified forms of energy equations are discussed, particularly for the cases with magneto-gas-dynamic approximations. The fundamental equations of magneto-gas-dynamics are also given. A.

538.3 : 531.51 : 530.12

RECIPROCITY BETWEEN SPACE–TIME AND ELECTROMAGNETIC EQUATIONS. See Abstr. 3941

538.311 : 621.3.013

4560. THE MAGNETIC FIELDS OF ISOLATED MOVING CHARGES. H.L.Armstrong.
Elect. Engng, Vol. 75, No. 6, 554-5 (June, 1956).

It is shown in detail that the magnetic field at a point due to (1) a moving electric point charge and (2) a current element, is interpretable in terms of the displacement current density at the point (instead of the more usually employed convection current at the source), use being made of the Maxwell equation

$$\operatorname{curl} \underset{\sim}{\vec{H}} = \underset{\sim}{\vec{J}} + \frac{\partial \underset{\sim}{\vec{D}}}{\partial t}.$$

B.Meltzer

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 532.5

4561. NOTES CONCERNING WAVES IN A HOMOGENEOUS MAGNETOACTIVE PLASMA. B.N.Gershman.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 707-9 (1956). In Russian.

Attention is drawn to Soviet work on the propagation and properties of waves in homogeneous plasma in a magnetic field of which Piddington (Abstr. 9779, 9790/1955; 499/1956) was presumably unaware, for many of the problems he raises are examined there. The present paper considers one of the Piddington problems, that of high-frequency waves, in greater detail and also the relation between the various types of normal plasma waves. The results are compared with those derived from a quasi-hydrodynamic and kinetic study. C.R.S.Manders

538.56 : 532.5

4562. HYDRODYNAMIC DESCRIPTION OF PLASMA OSCILLATIONS. B.B.Kadomtsev.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1083-4 (1956). In Russian.

The author limits himself to an examination of electron oscillations where ions and molecules can be considered to be infinitely heavy. Oscillation amplitude is considered to be small

and the distribution function is assumed to differ but little from Maxwellian. Taking electrons which have left the primary beam and made a collision, and are then assumed to achieve the conditions above, equations are derived to describe the effects, and these are hydrodynamic in form. A dispersion formula (reducible to the linearized Vlasov equation), is derived giving three solutions relating to (a) current with external field, (b) frequency of plasma oscillations taking friction into account, (c) electro-entropy wave. C.R.S.Manders

538.56.029.6 : 535

DEVELOPMENTS IN OPTICS AND MICROWAVES. See Abstr. 4107

538.565 : 621.372.413

4563. NON-RESONANT COUPLING OF RESONANT CAVITIES. P.D.Dunn, R.J.B.Hadden and D.J.Thompson.
Atomic Energy Res. Establ. (Harwell) Rep. GP/R 1962, 12 pp. (1956).

Deals with various non-resonant methods of coupling together E_{010} resonators loaded with posts. Coupling was achieved by plain, radial, annular, and dished holes and by wire loops. Bethe's theory is applied to the case of coupling of plain E_{010} cavities by circular holes and is compared with experiment. A.

538.566 : 534.24

4564. REFLECTION OF WAVES FROM AN ISOTROPIC INHOMOGENEOUS LAYER. A.G.Zharkovskiĭ and O.M.Todes.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 815-18 (1956). In Russian.

An approximate method for calculating the reflection coefficient of a plane electromagnetic wave from an isotropic inhomogeneous layer is given for a single space coordinate. The method can be also used in acoustics. A.

538.566

4565. DIFFRACTION BY A CONVEX CYLINDER. J.B.Keller.
New York Univ. (Inst. Math. Sci.) Rep. No. EM-94, 312-21 (July, 1956).

The leading term in the asymptotic expansion for large $k = 2\pi/\lambda$, of the fields reflected and diffracted by any convex cylinder are constructed. The cross-section of the cylinder is assumed to be a smooth curve which may be either closed or open and extending to infinity. The method employed is an extension of geometrical optics in two respects. First, diffracted rays are introduced. Secondly, fields are associated with the rays in a simple way. The results are applicable when the wavelength is small compared to the cylinder dimensions. A.

538.566 : 621.317.761

4566. MEASUREMENT OF INSTANTANEOUS FREQUENCY WITH A MICROWAVE INTERFEROMETER. H.P.Raabe.
Proc. Inst. Radio Engrs, Vol. 45, No. 1, 30-8 (Jan., 1957).

The apparatus consists of a transmission line circuit used as a frequency modulation discriminator, and an indicator consisting of a microwave detector, video amplifier, and oscilloscope. The discriminator transforms the frequency variation during r.f. pulses, or that of continuous waves, to an amplitude variation at the input of the indicator. The characteristics of the discriminator are investigated theoretically and conditions are discussed for adjustment of the discriminator in order to minimize linear and nonlinear distortions. Since amplitude deviations of the input wave will simulate frequency variations, a technique which greatly reduces this effect is presented. Analysis and experiments indicate that this method provides a practical technique for measuring the frequency and its stability during a radar pulse. A.

538.566 : 534.26

4567. ON THE PROPAGATION OF PULSES. I. DIFFRACTION OF PULSES BY WEDGES. F.Oberhettinger.
Z. Phys., Vol. 146, No. 4, 423-35 (1956). In German.

The diffraction of a plane or cylindrical electromagnetic or acoustic pulse by a perfectly reflecting wedge is investigated. The method applied is based upon the representation of a function by a Laplace transform and upon the solution of the corresponding time harmonic problem. A.

538.566 : 534.01 : 530.16

GENERAL THEOREMS ON THE EQUIVALENCE OF GROUP VELOCITY AND ENERGY TRANSPORT. See Abstr. 3985

538.566 : 621.318.12 : 621.372.821.2

4568. FERRITE SLABS IN TRANSVERSE ELECTRIC MODE WAVE GUIDE. H.Seidel.
J. appl. Phys., Vol. 28, No. 2, 218-26 (Feb., 1957).

The transversely magnetized slab operating in a parallel-plane-type transverse electric mode may be examined from an operational viewpoint. Characteristics of the waveguide mode emerge from considerations of symmetry and some results are derived that are not evident from a first-order perturbation theory. Operators are developed associated with various transverse strata of the waveguide cross-section corresponding to slabs of different media within the guide. The use of these operators is systematized in application to propagation problems in both rectangular and coaxial-type transmission lines. Ferromagnetic resonance is explored in ferrites obeying a reactive Polder tensor-type description and some features of resonance are discussed. A.

538.566

4569. ELECTROMAGNETIC TRANSMISSION CHARACTERISTICS OF A LATTICE OF INFINITELY LONG CONDUCTING CYLINDERS. Z.A.Kaprielian.
J. appl. Phys., Vol. 27, No. 12, 1491-502 (Dec., 1956).

The investigation is primarily concerned with the study of electromagnetic transmission characteristics of a lattice of infinitely long conducting cylinders. Four approaches to the general problem have been employed and the advantages, disadvantages, and realms of validity of each have been studied. Several of these methods constitute a substantial improvement over previous analyses and are supported by waveguide and free-space experimental work. The four approaches are: (1) A molecular analogy with a consideration dipole interaction leading to the Clausius—Mosotti relations, (2) A transmission line formulation which considers the thick obstacle for both polarizations, (3) An analysis based on the summation of scattered fields which demonstrates that the Clausius—Mosotti relations are a special case of a more general relation which accounts for the effects of higher order multipoles, and (4) A solution formally valid for all values of spacing and cylinder radius based on integral equation formulation of variational principle. A.

538.566.2

4570. REFLECTIONLESS TRANSMISSION THROUGH DIELECTRICS AND SCATTERING POTENTIALS. I.Kay and H.E.Moses.
J. appl. Phys., Vol. 27, No. 12, 1503-8 (Dec., 1956).

A complete solution is given for the problem of constructing a plane stratified dielectric medium having the property that at a fixed frequency and polarization a plane wave at any angle of incidence will be transmitted without reflection by the medium. This problem can also be interpreted quantum mechanically. The dielectric medium of the first interpretation becomes, in the second interpretation, a potential for the one-dimensional Schrödinger equation such that a particle which is sent in from $-\infty$ is transmitted with probability one of getting through to $+\infty$, no matter what the initial kinetic energy of the particle may be. In addition, the results can be applied to the problem of finding perfectly matched nonuniform transmission lines. A.

538.566.2

4571. EXTREMELY LOW-FREQUENCY ELECTROMAGNETIC WAVES. I. RECEPTION FROM LIGHTNING. L.Liebermann.
J. appl. Phys., Vol. 27, No. 12, 1473-6 (Dec., 1956).

Extremely low-frequency (ELF) radio waves (10-500 cycles) originating in lightning were received over distances in excess of 15 000 km. Transmission conditions were equally good, day or night. Propagation distances were ascertained by analysis of higher frequency components (> 1700 cycles) according to known methods. The receiving aerial employed an arrangement of grounded electrodes which uniquely determined the azimuthal direction of the source. Two distinct classes of ELF pulses are described which are attributed to different conditions of propagation. A.

538.566.2

4572. EXTREMELY LOW-FREQUENCY ELECTROMAGNETIC WAVES. II. PROPAGATION PROPERTIES. L.Liebermann.
J. appl. Phys., Vol. 27, No. 12, 1477-83 (Dec., 1956).

Properties of electromagnetic propagation at extremely low frequencies (below 500 cycles) are deduced from analysis of pulse distortion. The source of the transmitted pulse is lightning. Two distinct transmission types are analysed. Normal, or type I, propagation is shown to behave as if the earth's surface and ionosphere constitute a wave guide composed of two plane parallel surfaces, with one surface partially conducting. This wave guide has no low-frequency limit on propagation; attenuation formulae are given. The transmission properties of type II, or anomalous propagation, are derived and seen to be inexplicable by means of this wave-guide model. The analysis leads to a determination of the effective conductivity of the ionospheric reflector at these frequencies: the daytime reflecting layer (D-layer) conductivity is 10^4 e.s.u.; the nighttime conductivity (E-layer) is 5×10^4 e.s.u.; both results are far lower than deduced by other means. A.

538.566.3 : 621.396.1

4573. PHENOMENA OF THE INTERACTION OF RADIO WAVES: THE LUXEMBOURG EFFECT. A.Sciacchitano.
Scientia (Asso), Vol. 91, No. 7, 206-15 (1956). In Italian. French transl. in Supplement.

An explanation of the Luxembourg and gyro-interaction effects, with a historical review of the experimental investigations. These effects may be used to investigate ionospheric pressure, temperature, and other conditions. The former effect may be used to generate an artificial aurora. It is suggested that 2 kMW of radio energy at the correct frequency would produce an auroral light 100 times brighter than that of the full moon over a limited area, which could be used as an alternative to city street lighting, but only on a cloudless night. Many technical difficulties would have to be overcome and at least 500 kW would be needed to produce a noticeable aerial glow. The development of this idea for military and sea rescue operations on moonless nights and its advantages and disadvantages are discussed. J.J.Phipps

MOLECULAR AND ATOMIC STRUCTURE

539.1

THEORY OF SOLID STATE 539.11

539.11

4574. REMARKS ON THE CALCULATION OF CHARACTERISTIC TEMPERATURES OF CUBIC CRYSTALS FROM THE ELASTIC CONSTANTS. E.Tenerz.
Ark. Fys., Vol. 11, Paper 14, 247-52 (1956).

The Debye characteristic temperature θ_D for cubic crystals is calculated from the elastic constant, using the method first introduced by Bhatia and Tauber (Phil. Mag., Vol. 45, 1211, 1954). These authors expand the mean velocity of the three elastic waves in Kubic harmonics K_m of which they take only three into account. Extending that method by taking five K_m, of which the fifth is deduced here, a relatively simple expression for θ_D is still obtained. It is accurate even for large elastic anistrophy. A numerical comparison with Quimby and Sutton's (Abstr. 418/1954) method shows a very good agreement in the cases where this method is convenient to use. The numerical work is almost the same for both the methods in these cases, otherwise much less when Kubic harmonics are used. Values of θ_D for a number of substances and temperatures are calculated. The new calculation of θ_D for KCl at 0°K exhibits good agreement with measurements in the T^3-range. The fifth K_m can be of interest in other calculations. A.

539.11

4575. MODIFIED DEFORMABLE POTENTIAL FOR THERMAL SCATTERING OF ELECTRONS. J.B.Gibson and J.M.Keller.
Phys. Rev., Vol. 105, No. 2, 476-9 (Jan. 15, 1957).

In order to study thermal scattering of moderately bound electrons in a metal, corrections are considered to a deformable scattering potential. A constant multiple of the dilatation is derived that must be added to account for the correct zero of potential in a homogeneously deformed crystal. In an inhomogeneously deformed crystal (a crystal undergoing thermal vibrations), a function of the strain must be added to take care of charge redistribution. The deformable potential must also be modified to treat umklapp processes consistently. The modification provides that as the phonon wave vector increases in magnitude, some umklapp character must gradually be added to the scattering amplitude. A.

539.11

4577. PARAMAGNETIC RESONANCE AND NUCLEAR POLARIZATION IN THICK METALLIC LAYERS. M.Ya.Azbel', V.I.Gerasimenko and I.M.Lifshits.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 357-9 (1956). In Russian.

A generalized theory of paramagnetic resonance is presented which includes the nuclear polarization in metallic solids due to the spin resonance of electrons in the conduction band.

J.W.Gardner

539.11

4576. CALCULATION OF THE INTERATOMIC DISTANCE AT WHICH A MODEL OF COMPRESSED SOLID HELIUM BECOMES A METAL. C.A.ten Seldam.
Proc. Phys. Soc. A, Vol. 70, Pt 2, 97-109 (Feb., 1957).

In this paper, a calculation is attempted of the interatomic distance at which a face-centred cubic lattice of helium atoms becomes a metal, i.e., at which valence and conduction bands begin to overlap. Furthermore, the pressure which corresponds to this interatomic distance is estimated by means of the Thomas—Fermi equation of state. In one model used (the "ionic" one) an electron in the crystal sees a helium ion at the lattice position to which it is nearest, and neutral helium atoms at the other lattice positions; thus the "Fermi hole" is crudely accounted for, A slightly more refined model deals with exchange and correlation in a way similar to that of Bohm and Pines. In both cases, points of high symmetry in the Brillouin zone are used, and the Bloch wave-functions are expanded in terms of the corresponding suitable linear combinations of simple plane waves; the convergence problem involved is discussed. A.

MOLECULES 539.13

539.13

4578. CONTRIBUTION OF OTHER THAN NEXT NEIGHBORS IN ENERGY CALCULATIONS FOR NON-IONIC LIQUIDS AND SOLIDS. A.D.Crowell.
J. chem. Phys., Vol. 25, No. 6, 1264-5 (Dec., 1956).

The energy of interaction of an interior atom of a solid or liquid with the remainder of the atoms present is represented as consisting of two terms: (1) the interaction with Z next neighbours, and (2) the interaction with a uniform distribution of matter for the remainder of the atoms. If it is assumed that the energy of interaction between any pair of atoms in the solid or liquid can be written in the form kr^{-6}, it is shown that the contribution from other than next neighbours is equivalent to the interaction with one more next neighbour. As an application of this result, the corrections to the results obtained for the solid—liquid interface tension at the melting point by the next-neighbour approach are calculated. A.

539.13

4579. THIRD VIRIAL COEFFICIENT FOR INTERMOLECULAR POTENTIALS WITH HARD SPHERE CORES. B.J.Alder and J.A.Pople.
J. chem. Phys., Vol. 26, No. 2, 325-8 (Feb., 1957).

A general method is described for evaluating the third virial coefficient for any intermolecular potential in which the interaction varies as a sum of inverse powers of the distance outside a hard-sphere core. The calculations involve only simple algebraic operations and can be extended to include angular dependent potentials, quantum effects, and mixtures of molecules. An illustrative calculation on a modified Lennard-Jones potential shows the dependence of the third virial coefficient on the repulsive forces. A.

539.132 : 539.185

4580. MOLECULAR NEUTRON SPECTROSCOPY. V.I.Gol'danskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 717-18 (1956). In Russian.

Bombarding a target of the investigated molecules with pulses of monoenergetic neutrons (E_0 = 1-10 eV) one can determine the binding energy, the probability of different molecular transformations under the action of neutrons and data about rotational and vibrational states and the corresponding wave-functions of molecules.

Z.Krasucki

539.132 : 535.343

4581. INFRARED INVESTIGATION OF ACETIC ACID AND ACETIC ACID-d VAPORS AND A VIBRATIONAL ASSIGNMENT FOR THE MONOMERIC ACIDS. J.K.Wilmshurst.
J. chem. Phys., Vol. 25, No. 6, 1171-3 (Dec., 1956).

The infrared spectra of acetic acid and acetic acid-d, as vapours at 150°C, have been obtained from 2-25μ and an assignment of the fundamental vibrational frequencies made for the monomeric acids, with the exception of the two low lying type A'' torsional frequencies. Infrared spectra of the two acids, in the vapour phase, have also been obtained over the 5-15μ region at 25°, 65°, 105° and 150° and the effect of temperature on some of the frequencies discussed. A.

539.132

4582. HINDERED ROTATION IN MOLECULES WITH RELATIVELY HIGH POTENTIAL BARRIERS. K.T.Hecht and D.M.Dennison.
J. chem. Phys., Vol. 26, No. 1, 31-47 (Jan., 1957).

The theory of hindered rotation has been applied to the type of asymmetric molecule in which the hindering barrier is high enough so that the hindered rotation splittings of the energy levels are small compared with the rotational energies but yet large enough to be observable in the microwave spectrum. The specific type of molecule considered consists of a rigid asymmetric component which may undergo a hindered rotation about the symmetry axis of a rigid symmetric component where the symmetric component is in addition assumed to have threefold symmetry and the asymmetric component at least a plane of symmetry containing the symmetry axis of the symmetric component. An example might be the acetaldehyde molecule, CH_3CHO. In principle, the theory developed by Burkhard and Dennison can be used directly but in practice the method is difficult to apply to such a molecule since the matrix elements of the Hamiltonian used previously do not degenerate naturally or easily to those for the rigid asymmetric rotator in the infinite barrier limit. In the present treatment a transformation is made on the Hamiltonian whereby this complication is avoided and the resulting calculations are greatly simplified. It is found that the spectrum is essentially that of rigid rotator with the important exception that all the strong lines are split into two components. For the low J transitions specific formulae have been derived for these splittings which are relatively simple functions of the barrier height, the principal moments of inertia, and two additional parameters involving the molecular dimensions and the masses. The barrier height can thus be deduced from the observed splittings without the use of the somewhat cumbersome machinery needed in the general case. A.

539.132

4583. VIBRATION-HINDERED ROTATION INTERACTIONS IN METHYL ALCOHOL. THE J = 0 → 1 TRANSITION. K.T.Hecht and D.M.Dennison.
J. chem. Phys., Vol. 26, No. 1, 48-69 (Jan., 1957).

The hindered rotation fine structure of the J = 0 → 1, K = 0 → 0 transition which has been observed by Venkateswarlu, Edwards, and Gordy in normal methanol as well as in five additional isotopic species can be understood only qualitatively on the basis of earlier investigations of the theory of hindered rotation in methanol. It has been shown that the frequency separations between the various torsional transistions and the splitting of each of these can be explained quantitatively by including in the theory the effects of the vibration-hindered rotation interactions during the rotation of the whole molecular framework in space. The effects of the asymmetry of the rigid hindered rotator, the Coriolis interactions, and the centrifugal distortion of the molecule are discussed separately. A freuqency formula for the transition is derived which contains essentially only four new rotational constants. Three of these depend solely upon the known structure of the molecule and the elastic force constants and can therefore be calculated from a knowledge of the vibrational spectrum. Since this latter has never been analysed in more than a rough way some small adjustments have been made in the indicated values of the elastic constants which are within the limits of uncertainty. This adjustment is made for the normal molecule after which the three rotational constants are calculated for the remaining isotopic species without further adjustment. The fourth constant in the frequency formula describes the dependence of the barrier height upon the normal coordinates and is the only constant which must be determined empirically for each isotopic species. It has thus been possible to predict the 30 observed separations and splittings with the aid of essentially only six empirical constants. The agreement with experiment is remarkably good with one possible exception where the theory predicts for the fully deuterated methanol a very large splitting of the normal state line whereas the line in question is observed to be single. It is not improbable, however, that the large splitting actually exists and that the second component lay too far away to be recognized. A.

539.132

4584. "SENSITIVE" METHYL VIBRATIONAL FREQUENCIES — THEIR RELATION TO ELECTRONEGATIVITY AND THE INDUCTIVE EFFECT. J.K.Wilmshurst.
J. chem. Phys., Vol. 26, No. 2, 426-7 (Feb., 1957).

Plotting the squares of the rocking frequencies and the symmetrical deformation frequencies of methyl and silyl halides against the halogen electronegativities gives straight lines, which can then be used to derive effective electronegativities for other substituent groups, such as –OH, –SH, $-NO_2$. These effective electronegativities can be regarded as measuring the inductive effects associated with the groups. J.Hawgood

539.132 : 535.343

4585. THE VIBRATION SPECTRA OF AROMATIC COMPOUNDS. III. THE CALCULATION AND INTERPRETATION OF THE VIBRATION SPECTRA OF MESITYLENE AND DURENE. M.A.Kovner.
Optika i Spektrosk., Vol. 1, No. 3, 348-63 (1956). In Russian.

For Pts I and II see Abstr. 1087-8 (1955). The vibration frequencies of molecules of these substances are calculated and a full interpretation suggested for the fundamental and compound frequencies of Raman and infrared spectra of the above. The paper is entirely theoretical. C.R.S.Manders

539.132 : 535.343

4586. GENERAL THEORY OF THE VIBRATION SPECTRA OF NORMAL MONOALKYLBENZENES. M.A.Kovner and A.M.Bogomolov.
Optika i Spektrosk., Vol. 1, No. 3, 364-73 (1956). In Russian.

Vibration spectra are examined in general form in an attempt to show and prove theoretically that there are frequencies characteristic of all $C_6H_5(CH_2)_n CH_3$, and consequently not dependent upon n, as well as certain frequencies dependent upon n which make it possible to distinguish one monoalkylbenzene from another. C.R.S.Manders

539.132

4587. DIRECT l-TYPE DOUBLING TRANSITIONS IN ClCN. L.Yarmus.
Phys. Rev., Vol. 105, No. 3, 928-9 (Feb. 1, 1957).

Direct l-type doubling transitions have been observed in $Cl^{35}C^{12}N^{14}$ for J = 17, 18, 19 and 23. A formula has been constructed for the l-type doubling constant: $q = 7.467467 - 1.327 \times 10^{-5}J(J + 1)$. The absolute value of the asymmetry parameter η was determined to be 0.0101 ± 0.0004. A.

539.132 : 535.343

DEPENDENCE OF QUADRUPOLE COUPLING CONSTANT ON THE VIBRATIONAL STATE IN ICN MOLECULE. See Abstr. 4154

539.132

4588. A METHOD OF STUDYING THE ELECTRONIC TERMS OF DIATOMIC MOLECULES. THE ELECTRONIC TERMS AND LENGTHS OF MOLECULES OF THE ALKALI METALS AND THEIR HYDRIDES. F.Sh.Shifrin.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 4, 549-51 (1956). In Russian.

It is suggested that for diatomic molecules of the alkali metals with themselves, with each other and their hydrides, the product of corresponding excited state electronic term values, T_k, and internuclear distance, l, is constant. This rule enables "corresponding" term values to be picked out and unknown term values approximately evaluated. Ten such $T_k l$ products are chosen and the known energy levels assigned for the 20 compounds with fair agreement, except for Li_2. D.H.Whiffen

539.132

4589. ELECTRONIC STRUCTURE OF s-TETRAZINE. L.Paoloni.
J. chem. Phys., Vol. 25, No. 6, 1277 (Dec., 1956).

The semiempirical method of Pariser and Parr is used to account for the observed spectrum of s-tetrazine. The resonance integral $\beta_{CN} = -2.74$ eV was deduced from the observed spectrum, and $\beta_{NN} = -2.35$ eV was chosen to fit the observed spectrum. G.Allen

539.132

4590. CHARGE-TRANSFER COMPLEXES BETWEEN CHLORANIL AND POLYCYCLIC AROMATIC HYDROCARBONS. W.L.Peticolas.
J. chem. Phys., Vol. 26, No. 2, 429-30 (Feb., 1957).

The charge-transfer spectra of the complexes of a number of polycyclic aromatic hydrocarbons with chloranil have been determined. The frequency of maximum absorption is shown to be a linear function of the minimum carbon localization energy and approximately equal to the frequency of the corresponding singlet—triplet transition in the hydrocarbon. The results in terms of Mulliken's theory of charge transfer seem to indicate that the sum electron affinity of chloranil and the dissociation energy of the charged complex is equal to the ionization energy of the biradical which is practically constant in this series. R.C.Seymour

539.132 : 535.334

4591. THEORY OF THE HYPERFINE STRUCTURE OF ROTATIONAL SPECTRA OF MOLECULES, CAUSED BY ELECTRICAL 2^4-POLE MOMENTUM OF THE NUCLEUS. N.G.Basov, A.N.Oraevskiĭ and K.K.Svidzinskiĭ.
Optika i Spektrosk., Vol. 1, No. 3, 285-9 (1956). In Russian.

The theory of the above is developed for linear molecules and

for molecules of the type of a symmetrical gyroscope. For such molecules the operator is given for the total 2^4 electric moment and for the interaction energy of the 2^4 total moment of the nucleus with the molecular electric field. C.R.S.Manders

539.132

4592. THEORY OF THE HYPERFINE STRUCTURE OF NO [NITRIC OXIDE] MOLECULE. ELECTRONIC STRUCTURE. M.Mizushima.
Phys. Rev., Vol. 105, No. 4, 1262-70 (Feb. 15, 1957).

The calculation of the coupling constants of the magnetic and electric h.f.s. of the NO molecule is carried out using the Heitler–London wave-function with Hartree atomic wave-function. The homopolar ground-state is found to be expressed by a linear combination of four Slater determinants. This wave-function is used with success to calculate the spin-orbit coupling constant and the Λ-type doublet separation as well as the h.f.s. coupling constants. The "s-character" of the magnetic h.f.s. is explained by the configuration interaction with an excited state of the N atom, in which one of the 2s electrons is promoted to the 3s orbital. The effective number of the odd electron in the electric h.f.s. is 0.46, and Q for the N nucleus is 0.03×10^{-24} cm^2. No ionic structure needs to be considered. A.

539.132 : 535.332

TRIPLET–QUINTET TRANSITIONS IN THE SPECTRUM OF ATOMIC SILICON. See Abstr. 4127

539.132

4593. TEMPERATURE DEPENDENCE OF ELECTRON SPIN RESONANCE ABSORPTION OF THIOPHENOL IN SULFURIC ACID. Y.Yokozawa and I.Miyashita.
J. Phys. Soc. Japan, Vol. 12, No. 1, 107 (Jan., 1957).

A reduction of intensity of both lines of the electron spin resonance spectrum of thiophenol in sulphuric acid occurs with a temperature reduction and the lines are interpreted as belonging to an excited triplet state. D.H.Whiffen

539.132

4594. PROTON MAGNETIC RESONANCE IN ACETYLACETONE AND ITS KETO-ENOL EQUILIBRIUM. B.N.Bhar.
Ark. Kemi, Vol. 10, Paper 11, 223-5 (1956).

Using a slow sweep rate, nuclear magnetic resonance signals of acetyl acetone indicate 75% enol form which is in better agreement with the Br titration results (76%) than the earlier nuclear magnetic resonance results. D.H.Whiffen

539.132

4595. C^{13} NUCLEAR MAGNETIC RESONANCE SPECTRA. P.C.Lauterbur.
J. chem. Phys., Vol. 26, No. 1, 217-18 (Jan., 1957).

Chemical shifts and spin–spin coupling parameters are listed for C^{13} resonances detected in natural abundance in some 40 organic compounds. D.H.Whiffen

539.132

4596. THE USE OF PERTURBATION METHODS FOR QUANTUM-CHEMICAL INVESTIGATIONS OF SYSTEMS BUILT UP FROM IDENTICAL UNITS. R.Pauncz.
Acta phys. Hungar., Vol. 6, No. 3-4, 399-421 (1957).

The paper deals with the investigation of molecules built up from n identical units using perturbation considerations. By means of considerations based on a simple variant of the molecular orbital method both in the case of energy values and in that of bond orders were separated into sums of products in which one factor contains quantities referring only to the basic unit, and the second depends on the data of the series. The second part of the paper deals with the calculations relating to the polyrylene series in order to illustrate the usefulness of the general method. The results of the calculations show that the method can be successfully applied and that by its means it becomes possible to investigate the dependence of the quantities characterizing the series on the strength of the bonds connecting the single units. A.

539.132

4597. NATURE OF THE FREE ELECTRON APPROXIMATION: THE SIMPLE EXAMPLE OF THE H_2^+ ION. J.F.Hornig, W.Huber and H.Kuhn.
J. chem. Phys., Vol. 25, No. 6, 1296-7 (Dec., 1956).

A variational calculation for the 2pπ bonding and anti-bonding states of H_2^+ is used to test the validity of the assumption that a molecular one-electron wave-function may be written as the product of a function satisfying a one-dimensional effective Schrödinger equation along the molecular chain and a function of coordinates perpendicular to the chain, the latter function being common to all states. The assumptions are well justified, and the results agree well with experiment. J.Hawgood

539.132 : 541.57

4598. CALCULATION OF BOND EIGENFUNCTION MATRIX ELEMENTS WITH THE VECTOR MODEL. W.T.Simpson.
J. chem. Phys., Vol. 25, No. 6, 1297-8 (Dec., 1956).

The vector model corrected for non-orthogonality (Abstr. 2785/1957) is used to calculate matrix elements for an incomplete set of interacting structures. The secular equation for benzene using only the Kekulé structures is calculated as an illustration. J.Hawgood

539.132

4599. CENTRAL-FIELD APPROXIMATION FOR THE ELECTRONIC WAVE FUNCTIONS OF SIMPLE MOLECULES. K.Funabashi and J.L.Magee.
J. chem. Phys., Vol. 26, No. 2, 407-11 (Feb., 1957).

The use of a central-field type of molecular orbital for the electronic wave-functions of simple molecules has been investigated and application has been made to H_2, H_2O and CH_4. Ionization potentials calculated with the use of these wave-functions are generally in good agreement with experimental values. No empirical data have been used in these calculations except the known equilibrium dimensions of the molecules. Interactions of all electrons are included. Configuration interaction, however, is not used. Excitation potentials for H_2O and CH_4 are not in very good agreement with experimental values, which possibly means that configuration interaction cannot be neglected in such calculations. A.

539.132

4600. COMPARISON OF METHODS FOR COMPUTING BOND ORDERS AND ELECTRON DENSITIES. J.G.Burr, Jr.
J. chem. Phys., Vol. 26, No. 3, 431-4 (March, 1957).

The molecular orbital energy levels, charge distributions, and mobile bond orders for o-, m-, and p-toluidine in the ground state have been evaluated by three procedures: (1) the simple semiempirical LCAO with neglect of overlap; (2) the semiempirical LCAO method with one cycle of self-consistency iteration; (3) the semiempirical LCAO with inclusion of overlap integrals. It is observed that all three methods give closely similar values for the bond orders and charge distribution, and it is thus concluded that the simple method is as adequate to obtain these quantities as any of the refined methods. The dependency on the nitrogen Coulomb parameter of the total π-electron energy, of the energy of highest occupied orbital, of the charge distribution, and of the dipole moment for o-toluidine are reported and compared with the first order perturbation predictions. These calculations were accomplished on the electronic computer, ORACLE. A.

539.132 : 535.343

4601. ON THE APPLICATION OF THE MOLECULAR ORBITAL METHOD TO THE SPECTRA OF SUBSTITUTED AROMATIC HYDROCARBONS. L.Goodman, I.G.Ross and H.Shull.
J. chem. Phys., Vol. 26, No. 3, 474-80 (March, 1957).

The MO theory of the spectra of substituted hydrocarbons is presented in rather general terms, with careful emphasis on the precautions to be observed in introducing the inevitable approximations. Previous treatments of the problem, notably by Sklar, Herzfeld, and Matsen, are then examined. Satisfactory calculations of energy-level shifts are considered to require closer attention to the definition and dissection of the perturbed Hamiltonian. The most interesting intensity effects concern the enhancement of weak transitions: here earlier treatments do not satisfy the requirements of orthonormality of the perturbed MOs, and unjustifiably neglect interactions with intense transitions. The consequences of neglecting overlap in these calculations are discussed in an appendix. A.

539.132

4602. WHY NOT USE SLATER ORBITALS OF NONINTEGRAL PRINCIPAL QUANTUM NUMBER? R.G.Parr and H.W.Joy.
J. chem. Phys., Vol. 26, No. 2, 424 (Feb., 1957).

The use of such orbitals with n used as an additional variation parameter in the LCAO description of molecules, especially in the one-centre approximation, involves the use of complete and incomplete beta and gamma functions; it gives improved energies for a single configuration and improved convergence for configuration interaction treatments. J.Hawgood

539.132

4603. 1s ORBITALS AS BASE FUNCTIONS FOR MOLECULAR CALCULATIONS. R.G.Parr.
J. chem. Phys., Vol. 26, No. 2, 428 (Feb., 1957).

Any one-electron function can be expanded in a set of 1s orbitals centred on many different points and with different effective charges, and a good approximation can often be constructed of a small number of such functions. Using such a representation the calculation of the basic integrals would be simplified. J.Hawgood

539.132

4604. DETERMINATION OF THE MAGNETIC INTERACTION IN THE H_2 MOLECULE DUE TO THE MOTION OF TWO ELECTRONS. J. Ladik and A.Csukás.
Acta phys. Hungar., Vol. 6, No. 3-4, 381-97 (1957).

An approximate method is given for the wave-mechanical calculation of the magnetic interaction energy due to the motion of two electrons. The method is applied to the case of the H_2 molecule. By using Wang's approximation for the eigenfunctions and retaining his values for the parameters, an energy of 8.24×10^{-4} eV was obtained. This value agrees in magnitude with that calculated from the nuclear spin–spin magnetic interaction of H_2, and is about 60% of the electron spin–spin interaction energy as calculated for He; it is greater, however, by one order of magnitude than the magnetic interaction energy of the He atom resulting from the motion of the two electrons as calculated from the more accurate, retarded energy expression. In the course of the investigation it became necessary to determine two-centre integrals which are as yet unknown in the literature. Their calculation is given in the appendix. A.

539.132

4605. COLLISION-INDUCED DISSOCIATIONS IN THE MASS SPECTRUM OF METHANE. C.E.Melton and H.M.Rosenstock.
J. chem. Phys., Vol. 26, No. 3, 568-71 (March, 1957).

The mass spectrum of methane has been investigated in the pressure range 1×10^{-7} to 5×10^{-5} mm of Hg. A number of diffuse peaks were observed at nonintegral masses. These arise from dissociation of various ionized methane fragments on collision with residual methane gas in the field-free region of the mass spectrometer. The linear pressure dependence of their relative abundance points to single-collision processes. No multiple-collision processes or truly unimolecular metastable transitions were observed. A parallel between electron impact and collision-induced dissociation is pointed out. A.

539.133

4606. MICROWAVE STARK EFFECT MEASUREMENT OF THE DIPOLE MOMENT AND POLARIZABILITY OF CARBONYL SULFIDE. S.A.Marshall and J.Weber.
Phys. Rev., Vol. 105, No. 5, 1502-6 (March 1, 1957).

An improved microwave spectrograph has been developed which permits measurements of electric field intensity to one part in ten thousand. The instrument is employed to make precise Stark effect measurements. A method is also given for measuring the polarizability of polar molecules in a given rotational state. The transition $J = 1 \rightarrow 2$, $\Delta M = 0$ for the ground vibrational state of carbonyl sulphide (OCS) was studied and the electric dipole moment was determined and found to be (0.7124 ± 0.0002) Debye units. In addition the polarizability anisotropy $(\alpha_{zz} - \alpha_{xx})$ was measured and found to be $(2.4 \pm 3.0) \times 10^{-24}$ cm^3. Effects caused by the fourth-order term in the perturbation expansion for the Stark Effect were observed and found to be in good agreement with theoretical predictions. A.

539.133 : 535.375

4607. RAMAN SPECTRA AND FORCE CONSTANTS OF GeI_4 AND SnI_4. H.Stammreich, R.Forneris and Y.Tavares.
J. chem. Phys., Vol. 25, No. 6, 1278-9 (Dec., 1956).

The results indicate that GeI_4 and SnI_4 molecules have a regular tetrahedral structure with symmetry belonging to point group T_d. Comparison with previously recorded data is made. G.I.W.Llewelyn

539.133

4608. MOLECULAR STRUCTURE OF GASEOUS DINITROGEN TETROXIDE. D.W.Smith and K.Hedberg.
J. chem. Phys., Vol. 25, No. 6, 1282-3 (Dec., 1956).

Electron diffraction studies of N_2O_4 reveal that the molecule is coplanar in the gas phase, the N–N bond length is 1.75 A. The coplanarity is surprising in view of the long, weak N–N bond. G.Allen

539.133 : 535.343

BOND PARAMETERS IN VINYLIDENE CHLORIDE. See Abstr. 4156

539.133 : 535.343

4609. MICROWAVE DETERMINATION OF THE STRUCTURE OF TRIFLUOROBUTYNE. B.Bak, D.Christensen, L.Hansen-Nygaard and E.Tannenbaum.
J. chem. Phys., Vol. 26, No. 2, 241-3 (Feb., 1957).

The microwave spectrum of the symmetric tops, $CF_3C{\equiv}C{-}CH_3$ and $CF_3C{\equiv}C{-}CD_3$, has been investigated. Excited vibrational state transitions were observed, but the l-type doublet fine structure was not resolvable. Since lines originating from species containing C^{13} in natural abundance were identified, only two assumptions were necessary in order to determine the 7 structural parameters. The parameters giving the best fit with the experimental data are: $d(C,F) = 1.340$, $d(C(1),C(2)) = 1.455 = d(C(3), C(4))$, $d(C(2), C(3)) = 1.189$, and $d(C,H) = 1.097$ A and the angles $\angle F{-}C{-}F = 106^0 08'$ and $\angle H{-}C{-}H = 108^0 30'$. A.

539.133

4610. STUDY OF THE FORM AND DIMENSIONS OF MACROMOLECULES BY ELECTRON MICROSCOPY. T.A.Koretskaya and V.L.Karpov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 3, 621-2 (1956). In Russian.

Description of the method of preparing electron micrographs of individual molecules of high polymers by adsorption of the polymer from a very dilute aqueous solution onto a nitrocellulose film. A magnification of 25000 is used. The spots on the electronograph for thallium polymethacrylate are of the dimensions expected for individual molecules. R.C.Murray

ATOMS. NUCLEUS. ISOTOPES 539.15

539.152.1

4611. ON THE COLLECTIVE VIBRATIONS OF A SHELL STRUCTURE OF PARTICLES. A.Mouhasseb.
C.R.Acad. Sci.(Paris), Vol. 243, No. 18, 1289-92 (Oct. 29, 1956). In French.

It is shown that for the incomplete shells the parameter B associated with the mass transported by the collective flow can have values much larger than those expected for closed shells, as suggested by recent unpublished experiments. E.J.Burge

539.152.1

4612. MOMENTUM OF NUCLEONS IN VARIOUS NUCLEI FROM THE HIGH-ENERGY PHOTOEFFECT. A.Wattenberg, A.C.Odian, P.C.Stein, H.Wilson and R.Weinstein.
Phys. Rev., Vol. 104, No. 6, 1710-16 (Dec. 15, 1956).

The previously reported studies of the high-energy photoejection of neutrons and protons showed the basic validity of the "quasi-deuteron" model. Due to the motion of neutrons and protons in a complex nucleus one observes that the kinematics of the "quasi-deuteron" disintegration are modified from those of the photodisintegration of a free deuteron at rest. The modification of the kinematics was measured for Li, C, O, Al, and Cu in an attempt to compare the "average" momentum of the nucleons in these nuclei. It is found that a Fermi momentum distribution (with $T = 0^0$) does not fit the observed data. A calculation employing only conservation of momentum and assuming a three dimensional Gaussian momentum distribution for the neutrons and protons, gives an expression that fits the data quite well for Li, C, and O. The 1/e values of the Gaussians for Li, C, and O, respectively are 8, 19, and 19 MeV. These values have been corrected for the experimental angular resolution and for refraction at the nuclear surface. A.

539.152.1 : 539.152.2

4613. THE ACCURACY OF ISOBARIC SPIN IN NUCLEI WITH A $1f_{7/2}$ SHELL. V.G.Neudachin.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 892-3 (1956). In Russian.

Calculations analogous to those of Radicati (Abstr. 2957/1953) have been made for nuclei with 1d and $1f_{7/2}$ shells. It is shown that T is a good quantum number in a stable nucleus in which the external nucleons can exist in one shell. W.O.Lock

539.152.1

4614. INTERPRETATION OF REGULARITIES IN NEUTRON AND PROTON SEPARATION ENERGIES. A.de-Shalit.
Phys. Rev., Vol. 25, No. 5, 1528-30 (March 1, 1957).

Way's empirical rule on the behaviour of separation energies of nucleons is analysed. It is shown that this rule could be expected from general properties of the shell model, and the sort of information which can be obtained from its detailed analysis is discussed. A.

539.152.1

4615. PAIRING EFFECT IN NUCLEI. Y.F.Bow.
Phys. Rev., Vol. 105, No. 5, 1541-4 (March 1, 1957).

It has been previously pointed out by Suess and Kowarski that near the closed neutron shells N = 50 and N = 82 the pairing energy of protons is greater than that of neutrons. Glueckauf found the same situation existing in heavy nuclides. Kohman has suggested that this effect may be fairly general in the region of medium-weight and heavy nuclides; however, several regions in which the effect is in the opposite direction have also been reported. On the basis of a generalized atomic mass equation for odd-A nuclides, the function ϵ has been calculated, defined by Kohman as the difference between proton pairing energy π and neutron pairing energy ν. It turns out that Kohman's suggestion seems to be in the right direction but with a restricted sense. A theoretical explanation consistent with the assumptions proposed by Mayer for the j–j coupling single-particle model has been investigated. The effect on this explanation of the absence of odd-proton isomerism for $63 < Z < 82$ has also been discussed. A.

539.152.1

4616. DEFORMATIONS OF HEAVY NUCLEI. O.Miyatake, Y.Yoshizawa and M.Toyama.
Phys. Rev., Vol. 105, No. 4, 1341-5 (Feb. 15, 1957).

The value of the distortion parameter of an even-even nucleus which is derived by using the experimental values of the energy of the first excited state, is much greater than that determined from the lifetime of the first excited state of the same nucleus. This discrepancy is explained by assuming that there is a sort of rotational character of the nuclear matter and that the protons are distributed in a region slightly smaller than the whole nucleus. The mechanism of large deformations of eleven even nuclei is explained by applying the strong-coupling theory. The coupling constants between the extra particles and the nuclear surface are much smaller than those which have been used previously. The energies of the first excited states are calculated. A.

539.152.1

4617. LEVELS OF THE Li^6 NUCLEUS. Yu.L.Sokolov, M.M.Sulkovskaya, E.A.Al'bitskaya and E.I.Karpushkina.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1219-22 (1956). In Russian.

Lithium in nuclear emulsions was bombarded with deuterons of 17.5 ± 0.25 MeV energy. From the resulting interactions, the level scheme of Li^6 is deduced and isotopic spins are assigned. W.O.Lock

539.152.1

4618. ROTATIONAL PERTURBATIONS IN NUCLEI. APPLICATION TO WOLFRAM [TUNGSTEN] 183. A.K.Kerman.
K. Danske Vidensk. Selsk., mat.-fys. Medd., Vol. 30, Paper 15, 24 pp. (1956).

The characteristics of the rotational spectrum of W^{183} cannot be accounted for by the rotation–vibration correction. It is suggested that the rotation excites low-energy states of the structure, an effect similar to rotational perturbation in molecules. A theory of this effect is given, applicable to nuclei, and shown to fit well the data on W^{183}. A.

539.152.1

4619. ENERGY LEVELS OF ^{40}A. I.J.van Heerden and D.J.Prowse.
Phil. Mag. (Eighth Ser.), Vol. 1, 967-70 (Oct., 1956).

The protons inelastically scattered from a gaseous argon target have been examined at 9.5 MeV by means of the photographic emulsion technique, demonstrating the existence of levels in A^{40} at 1.48± 0.2, 2.22± 0.4, 3.12± 0.3, 3.80± 0.3, 4.50± 0.5, and 4.98± 0.5 MeV. Only those at 1.48 and 2.22 MeV have been observed previously. D.J.A.Prowse

539.152.1

4620. ENERGY LEVELS OF O^{18} AND F^{21}. N.Jarmie.
Phys. Rev., Vol. 104, No. 6, 1683-7 (Dec., 15, 1956).

The reactions $F^{19}(t,\alpha)O^{18}$ and $F^{19}(t,p)F^{21}$ have been studied, yielding the following results: the energy levels of O^{18} up to 6.8 MeV are 1.989, 3.504, 3.929, 5.007, 5.170, 5.311, 5.456, 6.190 and 6.238 MeV. The energy levels of F^{21} up to 2.14 MeV are 0.269, 1.087, 1.694 and 2.036 MeV. The mass defect of F^{21} is measured to be 6.195 MeV, giving a mass of 21.006 653 atomic mass units. The yields and cross-sections of the levels are studied. These results are compared with data obtained elsewhere and the isobaric systems of mass 18 and 21 are discussed. A.

539.152.1

4621. COMPARISON OF ENERGY LEVELS OF Li^6 FROM VARIOUS REACTIONS. C.P.Browne and C.K.Bockelman.
Phys. Rev., Vol. 105, No. 4, 1301-6 (Feb. 15, 1957).

The nuclear energy levels of Li^6 of excitations less than 5 MeV were studied by using inelastic scattering of deuterons and protons and the $Be^9(p,\alpha)Li^6$ reaction. An electrostatic accelerator and a broad-range magnetic spectrograph gave high precision and resolution. Levels were observed at 2.188 ± 0.006 MeV and at 3.560 ± 0.006 MeV, the former with all three reactions and the latter with all but deuteron scattering which is forbidden by the isotopic-spin selection rule. No other levels were observed. A study of the peak shapes yields 24 keV for the half-width of the 2.188 MeV level, in agreement with previous measurements on the compound nucleus. A.

539.152.1 : 539.172.4

4622. LOW-LYING LEVELS IN U^{238} EXCITED BY INELASTIC NEUTRON SCATTERING. R.C.Allen.
Phys. Rev., Vol. 105, No. 6, 1796-8 (March 15, 1957).

Analysis of neutrons inelastically scattered by U^{238} indicates that the first two excited states in U^{238} are at 50 ± 20 keV and 140 ± 25 keV. The inelastic collision cross-sections, the total inelastic scattering cross-sections, and the partial inelastic scattering cross-sections for the excitation of these levels are presented for neutron energies of 150, 250 and 500 keV. A.

539.152.1

4623. SPLITTING OF $^3S_1$ AND $^1S_0$ STATES IN Li^6. T.Tamura.
Phys. Rev., Vol. 105, No. 6, 1808-9 (March 15, 1957).

The splitting of the $^3S_1$ and $^1S_0$ states of Li^6 is calculated by applying Feingold's procedure of configuration mixing to the wave-function which was used in the author's earlier calculation of the binding energy of the same nucleus. It is found that the usually used tensor force is strong enough to explain the big value of this splitting. A.

539.152.1

4624. EXPERIMENTAL SINGLE-PARTICLE LEVEL SPACINGS IN THE REGION OF THE $1f_{7/2}$ SHELL. R.H.Nussbaum.
Rev. mod. Phys., Vol. 28, No. 4, 423-31 (Oct., 1956).

A review is presented on experimental information about the relative position of single-particle states in odd-A nuclei in the region of the $1f_{7/2}$ shell. In Appendix I a discussion of the assignments is given for all the included level schemes. Some striking empirical regularities in nuclei with odd nucleon numbers > 28 are mentioned in Appendix II. A.

539.152.1 : 539.172.13

4625. STUDY OF NUCLEAR ENERGY LEVELS BY MEASURING THE ANGLE OF EMISSION OF THE REACTION PRODUCTS. A.F.Tulinov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 698-9 (1956). In Russian.

The reactions $Be^9(d,p)Be^{10}$ and $Be^9(d,He^4)Li^7$ were studied by observing the angle of recoil of the nucleus for a fixed angle of the lighter particle which was emitted. The angle is different for the ground state and the excited states of the final nucleus. G.E.Brown

539.152.1 : 539.163.2

ENERGY LEVELS IN U^{236}. See Abstr. 3599

539.152.1

4626. ISOMERIC STATE OF W^{181}. A.J.Bureau and C.L.Hammer.
Phys. Rev., Vol. 105, No. 3, 1006-11 (Feb. 1, 1957).

An isomeric state of W^{181} is excited by a (γ,n) reaction on W^{182} using the X-ray beam of a 75 MeV synchrotron. The energy and half-life of the isomeric state are found to be 366 ± 4 keV and 14.4 ± 0.3 microsecond, respectively. A measurement of the K-shell conversion coefficient yields a value of 0.30 ± 0.03. These experimental data suggest that the transition is of mixed multipole order, 28% E1 + 72% M2. This assignment is in agreement with the transition probabilities computed from Nilsson's wave-functions for the first excited state and the ground state of the W^{181} nucleus. A.

539.152.2

4627. SPIN–ORBIT COUPLING EFFECT IN NUCLEAR MAGNETIC MULTIPOLE RADIATION. D.P.Grechukhin.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 513-15 (1956). In Russian.

Spin–orbit coupling leads to a weakening of angular momentum selection rules and a consequent increase in the transition probability $W_{mag}(l)$ for magnetic 2^l-pole radiation. Specific transition probabilities are calculated for the case of a 10 $m_e c^2$ (~ 5 MeV) transition in a nucleus of atomic number 100; it is found that $W_{mag}(l) \sim W_{elec.}(l+1)$ for l = 1,2,3. J.W.Gardner

539.152.2

4628. PARAMAGNETIC RESONANCE ABSORPTION IN URANIUM (III) CHLORIDE AND THE NUCLEAR SPIN, MAGNETIC DIPOLE MOMENT, AND ELECTRIC QUADRUPOLE MOMENT OF URANIUM-233. P.B.Dorain, C.A.Hutchison, Jr and E.Wong.
Phys. Rev., Vol. 105, No. 4, 1307-9 (Feb. 15, 1957).

Paramagnetic resonance absorption in single crystals of $U^{233}Cl_3$ diluted with $LaCl_3$ has been investigated. The values of the parameters in the appropriate Hamiltonian are given. The values of the nuclear spin, magnetic dipole moment, and electric quadrupole moment obtained from these studies are discussed. The ratios of the moments of U^{235} and U^{233}, which can be obtained with much higher accuracy than the individual moments, are given. A.

539.152.2

4629. REVERSIBILITY AND IRREVERSIBILITY IN NUCLEAR RESONANCE. J.Seiden.
C.R. Acad. Sci. (Paris), Vol. 243, No. 18, 1308-10 (Oct. 29, 1956). In French.

The proof referred to in Abstr. 2545 (1957) is outlined for a system of a large number of spins interacting with a "classical" thermal bath (lattice). Only the second-order terms are given in full. E.H.Sondheimer

539.152.2 : 548.7

4630. LINE WIDTH OF THE PURE QUADRUPOLE RESONANCE OF BROMINE IN $NaBrO_3$. Y.Kôi.
J. Phys. Soc. Japan, Vol. 12, No. 1, 49-53 (Jan., 1957).

Using a regenerative spectrometer the line-widths of the two bromine isotopes in $NaBrO_3$ were measured at melting-ice and liquid-oxygen temperatures. The full width at half-maximum intensity of Br^{79} is 3.85 ± 0.1 kc/s and that of Br^{81} is 4.09 ± 1 kc/s. No observable dependence of the line-width on temperature was found. From the ratio of the line-widths it is concluded that the main cause of the line-width in $NaBrO_3$ is the magnetic dipole interaction, and the contribution from the relaxation is of the order of 0.1 kc/s. A.

539.152.2

4631. GENERALIZED THEORY OF RELAXATION. F.Bloch.
Phys. Rev., Vol. 105, No. 4, 1206-22 (Feb. 15, 1957).

Presents a further generalization of an earlier theory by Wangsness and the author (Abstr. 2619/1953). In common with this theory, it is assumed that the spin system is weakly coupled to its molecular surroundings and that the latter can be considered as a heat reservoir which remains in thermal equilibrium at the absolute temperature T. The condition that the coupling is weak demands that its effects upon the spin system, calculated in first and second approximation and measured in a frequency scale, are small compared to the inverse of the correlation time τ_c as well as of the time $\beta = \hbar/kT$. The principal progress over the earlier work consists in the fact that it imposes no additional conditions upon the energy of the spin system; in particular, it dispenses with the necessity that the dominant part of this energy is independent of the time. A linear differential equation of the first order for the distribution matrix is derived which is valid in this very general case and which contains the earlier results as special cases. The derivation of this Boltzmann equation is carried out in a form which is independent of any particular representation, used for the spin system, and which leads directly to a system of differential equations for the expectation values of spin functions. Beyond the earlier results, it is shown that the coupling with the molecular surroundings leads in second approximation not only to relaxation terms but also to a correction of the spin energy which has the nature of a "self-energy". As a considerably more restricted case, the situation is investigated where the dominant part of the spin energy varies little during a time of order τ_c and β. It is shown that, in this case, relaxation causes the distribution matrix to tend towards the form, corresponding to thermal equilibrium at the instantaneous value of the dominant part of the energy. The case where the frequencies of the spin system as well as their relative rate of variation are small compared to $1/\tau_c$ but arbitrary compared to $1/\beta$, is likewise discussed and shown to lead to a simple form of the Boltzmann equation. The general formalism is finally applied to a spin system with a single spin of value 1/2, exposed to a rotating field. One obtains in this case a phenomenological equation for the expectation value of the spin vector which is far more general than the one derived earlier; instead of requiring merely the knowledge of the longitudinal and the transverse relaxation time, relaxation is here characterized by five time constants which may all be different. The stationary solution is derived and applied to a number of familiar special cases. A.

539.152.2

4632. MULTIPOLAR STARK SPLITTING PATTERNS IN SINGLE CRYSTALS. P.M.Parker.
Phys. Rev., Vol. 105, No. 6, 1713-15 (March 15, 1957).

The theoretical relative splitting schemes of the energy levels of a nuclear nonspherical charge distribution in the electrical field of the crystalline surroundings are calculated for some relevant symmetries of the electric crystalline field. The results are intended as a guide to possible experimental observations of nuclear multipole interactions of order higher than the quadrupole interaction. A.

539.152.2

4633. THEORY OF NUCLEAR MAGNETIC RESONANCE IN Eu^{3+}. R.J.Elliott.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 119-23 (Jan., 1957).

A calculation is made of the splitting of the energy levels of Eu^{3+} ions in their ground state which arises from the interactions of the nuclear magnetic moment with external and internal magnetic fields and of the nuclear quadrupole moment with the crystalline electric field. The feasibility of determining these nuclear properties by nuclear magnetic resonance is discussed. The method is applicable to all paramagnetic substances with singlet ground states. A.

539.152.2 : 538.54

4634. THE EFFECT OF EDDY CURRENTS ON NUCLEAR MAGNETIC RESONANCE IN METALS. A.C.Chapman, P.Rhodes and E.F.W.Seymour.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 345-60 (April, 1957).

A theoretical and experimental investigation of this effect is described. The theoretical treatment is developed for specimens in the form of (i) a flat plate, (ii) a long cylinder and (iii) a sphere; and is applicable to foils, wires and powders with spherical particles. In each case the power absorption per unit volume W is expressed as $W = W_0 + W_1$, where W_1 determines the nuclear resonance absorption and is of the form $W_1 \propto a\chi' + b\chi''$, where $(\chi' - i\chi'')$ is the complex susceptibility. Explicit expressions are derived for W_0, a and b as functions of $p = 2t/\delta$, where δ is the skin depth, and 2t is (i) the thickness of the plate, (ii) the diameter of the cylinder, (iii) the diameter of the sphere. These results indicate that both the dependence on reduced specimen dimension and the magnitude of the effect differ considerably from those previously supposed. Measurements of the nuclear magnetic resonance absorption in aluminium foils, in the temperature range $20^\circ K$ to $300^\circ K$, are described, and it is shown that the results are in satisfactory agreement with the theoretical treatment. The effect of eddy currents on the position of the centre, the shape and the amplitude of the absorption line are discussed, and methods of correcting observed lines to obtain the undistorted line are indicated. Extensions of the treatment to methods of observing nuclear resonance other than by absorption measurements are also outlined. A.

539.153 : 523.164

4635. INFLUENCE OF COLLISIONS UPON POPULATION OF HYPERFINE STATES IN HYDROGEN. E.M.Purcell and G.B.Field.
Astrophys. J., Vol. 124, No. 3, 542-9 (Nov., 1956).

In a collision between two hydrogen atoms in their ground states, the electron spins may exchange. Such exchanges affect the relative populations of the hyperfine levels and are therefore important in determining the rate of 21 cm transistions in an assembly of atoms undergoing collision. A cross-section is computed for electron exchange over a range of gas kinetic temperatures, and the competition between collisions and radiation in establishing the hyperfine populations is analysed. The results are applied to typical situations encountered in 21 cm radio astronomy. A.

539.153

4636. ELECTRON g VALUE IN THE GROUND STATE OF DEUTERIUM. J.S.Geiger, V.W.Hughes and H.E.Radford.
Phys. Rev., Vol. 105, No. 1, 183-8 (Jan. 1, 1957).

The ratio of the electron g_J in the deuterium ground state to the proton g_p in a cylindrical mineral oil sample has been measured. The measurement was made using the microwave magnetic resonance absorption method and apparatus which Beringer and Heald used to determine $-g_J/g_p$ for hydrogen. The three strong-field Zeeman transitions having $\Delta m_J = \pm 1$, $\Delta m_I = 0$ were observed at a frequency of 9200 Mc/s. Accuracy was limited by the minimum observed line widths of 20 parts per million resulting principally from magnetic field inhomogeneities. When one uses the Breit–Rabi formula, the unweighted mean of 68 observations yields $-g_J(D)/g_p = 658.2162$ with an assigned error of ± 0.0008. The ratio of this value to the value of $-g_J(H)/g_p$ obtained by Beringer and

Heald, who used an identical mineral oil sample is $g_J(D)/g_J(H) = 0.9999983 \pm 0.0000015$, and to the value of $-g_J(H)/g_p$ of Koenig, Prodell and Kusch, after suitable diamagnetic corrections, is $g_J(D)/g_J(H) = 0.9999997 \pm 0.0000023$. These values are in agreement with the theoretically expected value of $g_J(D)/g_J(H) = 1$ and with the less precise direct measurement of Nelson and Nafe. A.

539.153

4637. MESONIC ATOMS: RADIATIVE YIELDS OF THE μ-MESON K AND L SERIES AND THE EFFECT OF MESON CAPTURE IN CHEMICAL COMPOUNDS. M.B.Stearns and M.Stearns.
Phys. Rev., Vol. 105, No. 5, 1573-82 (March 1, 1957).

The radiative yields of the K and L series of μ-mesonic atoms have been measured for the elements $_3$Li through $_{19}$K. In the low-Z region both yield curves exhibit a rapid decrease in yield with decreasing Z. This behaviour is attributed to competition between Auger and radiative transitions. However, if this is true, the Auger transition probabilities would have to be about 300 times larger than the calculated values for the μ–K yields, and about 30 times larger for the μ–L yields. The effect of meson capture by the different elements of a compound has been measured for Al_2O_3 and CaS. For these compounds it is found to be proportional to Z within 10 to 20%, in agreement with the prediction of Fermi and Teller. A.

539.153.4

4638. DISTRIBUTION OF ELECTRON DENSITY IN THE EXTENDED STATISTICAL ATOMIC MODEL, WITH KINETIC ENERGY CORRECTION. P.Gombás.
Acta Phys. Hungar., Vol. 5, No. 4, 483-502 (1956). In German.

Using a kinetic energy correction, the extended statistical fundamental equation for the noble gas atoms Ne, A, Kr and X is solved numerically, and the electron density determined. The new density is constant in the neighbourhood of the nucleus, but at greater distances from the nucleus falls exponentially to zero. It is in good agreement with the wave-mechanical results obtained from the self-consistent field distribution of the Hartree–Fock atom, and is an essential improvement in relation to the results obtained from the Thomas–Fermi and Thomas–Fermi–Dirac distributions: in the former of these the density falls to zero much too slowly, and in the latter it drops to zero by unequal finite decrements. It is also considered that the correction given here is an improvement on the original Weizsäcker correction. A.J.Mee

539.153.4

4639. CALCULATION OF THE ELECTRON AFFINITY OF ALKALI ATOMS AND OF THE IONIZATION ENERGY OF THE Ca ATOM. L.Szász.
Acta phys. Hungar., Vol. 6, No. 2, 307-17 (1956).

Gombás's method taking into account the interaction between the atomic core and the valency electrons is applied to the solution of the two-electron problem. The method essentially consists in replacing the postulate that the eigenfunction of the valency electron should be orthogonal to that of the core electrons by a repulsive potential. Using for the potential Hellmann's semi-empirical expression the electron affinity of alkali atoms and the ionization energy of the Ca atom have been calculated. The eigenfunction of the two-electron problem has been assumed in a form including the correlation between the electrons, which corresponds to Hylleraas' second approximation; the third approximation has been estimated. The calculations show that Gombás's method can account for the stability of negative alkali ions. A.

539.153.4

4640. APPROXIMATE SOLUTION OF THE THOMAS–FERMI EQUATION WITH AMALDI–FERMI BOUNDARY CONDITION. T.Tietz.
J. chem. Phys., Vol. 26, No. 2, 430 (Feb., 1957).

The approximate solution discussed in Abstr. 9025 (1955) is corrected with the Amaldi–Fermi condition, for free neutral atoms. The agreement with Fermi's numerical solution is reasonable, as is that of the calculated diamagnetic susceptibilities of inert gases with experiment. J.Hawgood

539.153.4

4641. FOK [FOCK] SELF-CONSISTENT FIELD IN THE MULTI-CONFIGURATIONAL APPROXIMATION FOR THE HELIUM ATOM. Ya.I.Vizbaraĭte, V.I.Shironas, V.I.Kavetskis and A.P.Yutsis.
Optika i Spektrosk., Vol. 1, No. 3, 277-81 (1956). In Russian.

The $2p^2$, $2s^2$, $3d^2$ and $3p^2$ configurations are taken as basic configurations of the He atom and the Fok equations solved for them. With these solutions values are obtained for the correction to the energy of the basic configuration at different multi-configurational approximations. The authors also extend the Fok method to 6-configurational approximation $1s^2–2p^2–2s^2–3d^2–3p^2–2p3p$. Experimental and theoretical values of the energy are compared. C.R.S.Manders

539.153.4

4642. MULTICONFIGURATIONAL APPROXIMATION IN THE CASE OF ATOMS OF THE He TYPE. Ya.I.Vizbaraĭte, V.I.Kavetskis and A.P.Yutsis.
Optika i Spektrosk., Vol. 1, No. 3, 282-4 (1956). In Russian.

The multiconfigurational approximation is applied to the basic configuration of atoms of the He type from H^- to C^{4+} in such a way that, in the case of the basic configuration, use is made of self-consistent field results. Using hydrogen-type analytical wave-functions corrections are determined for the energy in multiconfigurational approximation, the net result being an improvement upon values given by other considerations. C.R.S.Manders

539.153.4

4643. EFFECT OF THE ATOMIC CORE ON THE NUCLEAR QUADRUPOLE COUPLING. R.M.Sternheimer.
Phys. Rev., Vol. 105, No. 1, 158-69 (Jan. 1, 1957).

The effect of the atomic core on the nuclear quadrupole coupling has been evaluated for several atomic ground states and excited states. It has been shown that for the excited states of the alkali, as the principal quantum number n is increased, the ratio R of the induced effect to the direct interaction with the valence electron tends toward a constant asymptotic value which is of the same order as for the first excited state (~ -0.1 to -0.3). The sensitivity of R to inaccuracies in the zero-order core wave-functions and valence wave-functions has been investigated. Equations have been derived for the exchange terms in the quadrupole coupling due to the perturbation of the valence wave-function by the nuclear quadrupole moment. The present calculations indicate that the exchange terms do not affect significantly the net antishielding obtained for the excited states of the alkalis. A.

539.153.4

4644. THERMODYNAMIC PROPERTIES OF MIXTURES ON THE STATISTICAL MODEL. J.J.Gilvarry and W.G.McMillan.
Phys. Rev., Vol. 105, No. 2, 579-80 (Jan. 15, 1957).

A new method of deriving Brachman's results for the thermodynamic functions of the Thomas–Fermi atom is given in a generalized form applicable to mixtures of electrons and light nuclei in the field of a heavy nucleus. A.

539.153.4 : 537.533.9

4645. ELECTRON EXCITATION OF 3p LEVELS OF O I. I.C.Percival.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 241-52 (April, 1957).

The collision strengths for low-energy electron excitation of O I from the ground level to the $2p^3(^4S)3p\ ^5P$ and ^3P excited levels have been calculated using the distorted wave Born–Oppenheimer approximation, and the ^5P collision strength using the exchange-distorted wave Born–Oppenheimer approximation. Difficulty with the orthogonality properties of the radial functions of the 3p orbitals leads to an investigation of the approximate atomic wave-functions used in the calculations. A comparison of fine-structure separations suggests that for the ^3P excited level a single-configuration Hartree–Fock wave-function with one parent term is insufficiently accurate for the calculation of these collision strengths. A similar comparison leads to an improved estimate of the ^5P collision strength, though various corrections to the estimate might modify it within wide bounds. A method of calculating certain exchange integrals is described. It is concluded that before calculating collision cross-sections for similar processes, great care should be taken to ensure that the atomic wave functions are sufficiently accurate. A.

539.153.4

4646. A SIMPLE ANALYTIC WAVE FUNCTION FOR He $1s2s\ ^1S$. R.Marriott and M.J.Seaton.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 296-8 (April, 1957).

An additional restriction is imposed on anti-symmetrized product wave-functions for He $1s2s\ ^1S$ if the 2s orbital is made orthogonal to the 1s orbital of the excited state. Variational calculations have been carried out using simple analytic wave-functions. The condition of orthogonality of orbitals is not imposed but the total wave-function for $1s2s\ ^1S$ is made orthogonal to a simple approximate $1s^2\ ^1S$ function. Evidence is presented relating to the accuracy of the function obtained. A.

539.153.4 : 537.533.74

TRANSITIONS IN HELIUM DUE TO ELECTRON BOMBARDMENT. See Abstr. 4456

539.153.4 : 537.564

CONVERSION OF METASTABLE HELIUM FROM THE SINGLET TO THE TRIPLET STATE BY ELECTRON COLLISION. See Abstr. 4496

539.155.2 : 541.135.3

4647. ISOTOPE ENRICHMENT BY COUNTERCURRENT ELECTROMIGRATION IN MOLTEN SALTS. A.Lundén.
Göteborg: Chalmers Tekniska Högskola (1956) 114 pp. [Doktorsavhandlingar No. 12].

A detailed description of the theory, apparatus, experimental conditions, accuracy, etc. of the countercurrent method is given. The empirical and theoretical systematic relations between the determined mass effects for Cl^-, Br^-, Li^+, K^+, Cu^{++}, Zn^{++}, Ag^+, Cd^{++}, Tl^+ and Pb^{++} in a number of salts are discussed. A review of isotope enrichment of some 18 elements is given. W.Good

539.155.2

4648. THE INFLUENCE OF TEMPERATURE ON THE ISOTOPIC SEPARATION BY THE EFFECT OF A DIRECT CURRENT IN MOLTEN GALLIUM. M.Goldman, G.Nief and E.Roth.
C.R. Acad. Sci. (Paris), Vol. 243, No. 19, 1414-16 (Nov. 5, 1956). In French.

The isotopic separation is shown to increase with temperature, contradicting previous theories. H.C.Cole

539.155.2

4649. NITROGEN ISOTOPE EFFECT IN THE DISTILLATION OF N_2O_4. G.M.Begun.
J. chem. Phys., Vol. 25, No. 6, 1279-80 (Dec., 1956).

By the distillation at atmospheric pressure and 21°C of N_2O_4 in a 30 plate bubble-cap column and assuming a bubble-plate efficiency of 60% a single stage separation factor of 1.0038 was obtained. Also on the assumption that the separation factor between N_2O_4 (l) and N_2O_4 (g) is small compared with that between N_2O_4 (l) and NO_2 (g), the latter separation factor was calculated to be approximately 1.023 (N_2O_4 (g) is 16.5% dissociated at 21°C). Values of the nitrogen separation factors between the gas and liquid phases were obtained in two other ways. From a single stage equilibrium an effective single stage factor of 1.0031 ± 0.0015 was obtained and from a Rayleigh distillation of N_2O_4 a single stage factor of 1.0042. H.C.Cole

539.155.2 : 541.14

4650. PREPARATION OF PURE MERCURY ISOTOPES FROM NATURAL MERCURY BY MERCURY PHOTOSENSITIZATION. R.Pertel and H.E.Gunning.
J. chem. Phys., Vol. 26, No. 1, 219 (Jan., 1957).

A brief review of previous experimental work is given which shows that separations up to 1½ times natural in the case of Hg^{198} and Hg^{202} can be achieved. The experiments are performed by exposing a substrate gas, (air, N_2 and water vapour etc.) presaturated with natural mercury vapour, to the 2537 A resonance radiation from an electrodeless discharge-tube containing a single isotope of mercury. In the group of substrates in which the Hg 6 ($^3P_1$) photosensitization leads to the formation of mercury compounds, the possibility exists of obtaining highly enriched isotopes from the reaction. The authors show that by adding butadiene C_4H_6 to the substrate gas, Hg^{202} can be enriched from its natural value of 29.6% up to 77%. The results suggest that the butadiene serves to suppress unwanted secondary reactions. H.C.Cole

539.155.2

4651. ENRICHMENT OF BORON WITH THE ISOTOPE B^{10}. M.Ya.Kats, G.M.Kukavadze and R.L.Serdyuk.
Zh. tekh. Fiz., Vol. 26, No. 12, 2744-8 (1956). In Russian.

An apparatus is described for the rectification of BCl_3 which which increases the concentration of B^{10} from 19.6% to 29.9%. W.O.Lock

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16.08 : 539.166.83

4652. MEASUREMENTS OF THE GAMMA RADIATIONS FROM Br^{82} BY THE METHOD OF EXTERNAL CONVERSION. S.Hultberg and A.Hedgran.
Ark Fys., Vol. 11, Paper 27, 369-77 (1956).

The gamma-ray emission following the decay of Br^{82} has been investigated. The energies of the rays have been accurately determined and their intensities estimated. A calculation of the theoretical dosage rate in röntgens/(hour·mc) at 1 cm in air from obtained energy and intensity data gives very good agreement with an experimental value from 4π-G.M. counter and $\beta\gamma$-coincidence measurements. A.

539.16.08

4653. A MICROCHEMICAL METHOD FOR THE PREPARATION OF SOURCES OF ACTINIUM AND EUROPIUM FOR β-RAY SPECTROSCOPY. S.Bjørnholm, O.B.Nielsen and R.K.Sheline.
Nature (London), Vol. 178, 1110-1 (Nov.17, 1956).

The activity, in essentially carrier-free form, is concentrated on a very small ion-exchange column and subsequently eluted with a strong eluting agent (ammonium lactate), picked up on a thin ($150\,\mu g/cm^2$) Al foil, dried, and the ammonium lactate evaporated off by heating. The overall yield is 30-80%, and the process takes 2-3 hours; the effective thickness of the sources is $\sim 5\,\mu g/cm^2$. A.O.Stanesby

539.16.08

4654. RADON CONTENT OF THE AIR. F.Běhounek and M.Majerová.
Nature (London), Vol. 178, 1457 (Dec. 29, 1956).

The method of measuring the radioactivity of the air (i.e. its radon content) by sampling the short-lived radon deposits on filter paper cannot be expected to yield correct results because most of the radioactivity is attached to very small particles (especially of two diameters: 9 and 18 mμ), which pass through the filter. Anderson, Mayneord and Turner found that the value given by the filter method in free air was only 2-3% of the true value. This could be explained by lack of equilibrium between radon and its daughter products in the free air. The authors made similar tests in a closed room and found that here too there is no constant ratio between the active deposit collected by the filter and the radon content of the air. V.Quittner

539.16.08

4655. CONTINUOUS ALPHA AIR MONITOR. D.R.Sawle.
Nucleonics, Vol. 14, No. 8, 90-5 (Aug., 1956).

This instrument provides continuous indication of the presence of dangerous long-lived heavy-element isotopes. A stationary air-filter is continuously monitored by a scintillation α-detector. The background due to the natural radon activity of the air is discriminated against by rejecting pulses corresponding to energies greater than 6.1 MeV. High accuracy is not claimed but the instrument will give warning of dangerous levels of uranium in the air before half-a-day's dose has been received. R.D.Smith

539.16.08

4656. FAST-NEUTRON-INSENSITIVE CHEMICAL GAMMA-RAY DOSIMETER. S.C.Sigoloff.
Nucleonics, Vol. 14, No. 10, 54-6 (Oct., 1956).

Acid formation in stabilized chloroform or tetrachlorethylene serves as a measure of gamma-ray dose that is rate- and temperature-independent and linear to over 200 000 r. The preparation and estimation of the solutions are described. The fast neutron response is $< 2\%$ of the gamma-ray response. R.D.Smith

539.16.08 : 537.542

CHERENKOV COUNTER FOR HIGH-ENERGY BETA-RAYS. See Abstr. 4475

539.162 : 539.152.1

4657. SYSTEMATICS OF NUCLEAR DECAYS. I. β- AND γ-SPECTROSCOPY. II. SPECTROSCOPIC REGULARITIES. A.Bisi, E.Germagnoli and L.Zappa.
Energia nucleare, Vol. 3, No. 4, 266-86 (Aug. 15,); No. 5, 376-89 (Oct. 15, 1956). In Italian.

In Pt I, after an introduction on the sources of information on nuclear levels, on nuclear systematics and on the accuracy of experimental methods, a review is given of experimental results on β-spectra, K- and L-shell capture, γ-rays, internal conversion, half-lives and angular correlations; the results are compared with theoretical predictions. Part II deals with the shell model of the nucleus, the Bohr—Mottelson collective model and regularities in β- and γ-decays. L.Pincherle

539.163

4658. RADIONUCLIDES IN FUSED ENAMEL MAKE STABLE RADIATION SOURCES. C.Blincoe.
Nucleonics, Vol. 14, No. 8, 82-3 (Aug., 1956).

Details of the preparation of Pm^{147}, Tl^{204}, Sr^{90}—Yt^{90} and Cr^{51} sources as fused enamels on metal or glass supports. Excellent chemical stability and low β-ray self absorption are claimed. R.D.Smith

539.163

4659. HALF-LIFE OF Th^{232} AND THE BRANCHING RATIO OF Bi^{212}. F.E.Senftle, T.A.Farley and N.Lazar.
Phys. Rev., Vol. 104, No. 6, 1629-32 (Dec. 15, 1956).

The half-life of Th^{232} has been calculated by determining an absolute gamma disintegration rate for Tl^{208} in equilibrium with Th^{232} for the three old thorium nitrate salts and one natural thorite sample. The branching ratio, $\alpha/(\alpha + \beta)$, for Bi^{212}, a necessary parameter in the calculation, was also measured. The half-life of Th^{232} was found to be 1.42×10^{10} years within an estimated error of 5%, which is essentially in agreement with the presently accepted value. The branching ratio, $\alpha/(\alpha + \beta)$, of Bi^{212} was found to be 0.362 ± 0.006, about 7.4% higher than the currently accepted value. A.

539.163

4660. ENERGY LEVELS IN Ga^{69} FROM THE DECAY OF Ge^{69}. R.H.Nussbaum and S.K.Suri.
Phys. Rev., Vol. 105, No. 4, 1272-7 (Feb. 15, 1957).

Using beta- and gamma-scintillation spectrometers for γ-γ and β-γ coincidence experiments, the decay of Ge^{69} (40 hr) has been reinvestigated. The main positron branch (1.22 MeV; 93%) proceeds directly to the ground state of Ga^{69}. Probably nine higher levels are mainly excited by electron capture transitions. From coincidence relations a tentative decay scheme is proposed. The half-life was found to be 40.4 ± 0.3 hr. A.

539.163

4661. NEW NEUTRON-DEFICIENT ISOTOPES OF RHENIUM. B.C.Haldar and E.O.Wiig.
Phys. Rev., Vol. 105, No. 4, 1285-7 (Feb. 15, 1957).

Three new activities have been observed in rhenium obtained by bombardment of rhenium and of tungsten with protons of energies from 40 to 240 MeV and of enriched W^{180} with 10 MeV protons. Positron-emitting Re^{177} of 17 min half-life was identified through its daughter, the known 2.2 hr W^{177}. Evidence is presented for the assignment of Re^{178} to a 15 min, 3.1 MeV positron activity and of R^{180} to a (20 ± 1) hour, 1.9 MeV positron activity. A previously reported unknown Re activity of approximately 1 hr half-life, which may possibly be an isomer of Re 186, was also observed. A.

539.163

4662. NEW RADIOISOTOPE OF PLATINUM — Pt^{200}. L.P.Roy, J.C.Roy and J.S.Merritt.
Phys. Rev., Vol. 105, No. 4, 1337-8 (Feb. 15, 1957).

A new radioisotope of platinum, Pt^{200}, with an 11.5 hr half-life has been produced by successive neutron capture in Pt^{198}. It was identified by milking its daughter, Au^{200}. The activation cross-section for the reaction $Pt^{199}(n,\gamma)Pt^{200}$ is approximately 15 barns. A.

539.163 : 523.841.11

SUPERNOVAE AND CALIFORNIUM 254. See Abstr. 3924

539.163.1

4663. HALF-LIVES OF COBALT-60, THALLIUM-204, AND EUROPIUM-152. E.E.Lockett and R.H.Thomas.
Nucleonics, Vol. 14, No. 11, 127 (Nov., 1956).

Continuation of earlier measurements (Abstr. 4982/1953) on sources of these nuclides have resulted in the following more accurate values for the halflives: Co^{60} = 5.20 ± 0.03 years, Eu^{152} = 12.7 ± ± 0.2 years. Measurements with the Tl^{204} source are consistent with the presence of two periods of 4.07 years (Tl^{204}) and 1.22 years (unidentified). R.D.Smith

539.163.1

4664. HALF-LIVES OF Sc^{46}, Co^{60}, Zn^{65}, Ag^{110m}, Cs^{134}, AND $Eu^{152,154}$. K.W.Geiger.
Phys. Rev., Vol. 105, No. 5, 1539-40 (March 1, 1957).

The half-lives of six gamma-emitting nuclides were determined by comparison with radium standards, using a lead-shielded ionization chamber. The following results were obtained: Sc^{46}: 83.89 ± 0.12 days; Co^{60}: 5.24 ± 0.03 years; Zn^{65}: 243.5 ± 0.8 days; Ag^{110m}: 252.5 ± 1.5 days; Cs^{134}: 2.07 ± 0.02 years; $Eu^{152,154}$: 12.2 ± 0.2 years. The errors quoted are twice the standard deviation calculated from a least-squares analysis. A.

539.163.2 : 539.152.1

4665. ON THE HIGH ENERGY GAMMA-TRANSITIONS OF W^{182}. G.Bäckström.
Ark. Fys., Vol. 10, Paper 28, 387-91 (1956).

Using a double-focusing magnetic spectrometer, the energies of the DB, FB and DA γ-rays have been redetermined, giving 1121.6 ± 0.2, 1189.3 ± 0.2 and 1221.8 ± 0.2 keV respectively. The existence of a weak FA γ-ray (1289 keV) has been confirmed. New γ-rays of 1254 ± 0.25 and 1273 ± 0.25 keV are interpreted as the EA and HB transitions respectively. No γ-rays could be detected in the region 1300-1500 keV. J.J.Wilkins

539.163.2 : 539.152.1

4666. LEAD AND THALLIUM ISOTOPES IN THE MASS RANGE 195-199. G.Andersson, E.Arbman and B.Jung.
Ark. Fys., Vol. 11, Paper 21, 297-322 (1956).

The following nuclides have been produced by irradiation of Tl in a synchrocyclotron and studied in a β-spectrometer: 12.2 min Pb^{199m}, 1.5 hr Pb^{199}, 2.4 hr Pb^{198}, 42 min Pb^{197m}, 37 min Pb^{196}, 17 min Pb^{195m}, 2.7 hr Tl^{197}, 2.4 hr Tl^{196} and 1.2 hr Tl^{195}. An electromagnetic isotope separator was used to make mass assignments. All activities except Pb^{199m} seem to decay mainly by electron capture. In addition positron branches probably occur in several cases. Fragmentary decay schemes, supported in part by electron–electron coincidence measurements, have been constructed for the odd mass numbers. A contribution to the knowledge of nuclear level systematics in this region with primary emphasis on the odd mass nuclei is also made. A.

539.163.2

4667. A SEARCH FOR DOUBLE β^--DECAY IN Ca^{46}. E.I.Dobrokhotov, V.R.Lazarenko and S.Yu.Lyk'yanov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 6, 966-9 (1956). In Russian.

Scintillation counter experiment both above and below ground, but with negative result, suggesting double decay period $> 10^{18}$ years. W.O.Lock

539.163.2

4668. POSSIBLE FINITE NUCLEAR SIZE EFFECT ON THE 279 keV TRANSITION IN Tl^{203}. C.Nordling, K.Siegbahn, E.Sokolowski and A.H.Wapstra.
Nuclear Physics, Vol. 1, No. 5, 326-31 (April, 1956).

The measured K and $L_{I,II,III}$ conversion coefficients of this transition confirm that the theoretical values must be corrected by a factor of about 0.6; the transition appears to be M1 + E2 with a mixing ratio (a = E2/M1) of about 0.6. A.O.Stanesby

539.163.2

4669. THE NATURAL RADIOACTIVITY OF LANTHANUM. R.N.Glover and D.E.Watt.
Phil. Mag. (Eighth Ser.), Vol. 2, 49-56 (Jan., 1957).

The decay of La^{138}, the middle member of a naturally occurring isobaric triplet, is studied by means of heavily shielded scintillation and proportional tube spectrometers. The existence of only two of three γ-rays reported by earlier investigators is confirmed, their energies being (0.81 ± 0.01) and (1.44 ± 0.02) MeV. No annihilation quanta were observed. Coincidence studies show that these γ-rays are not in cascade, and that the 1.44 MeV transition belongs to the electron-capture branch. A previously unobserved β-ray spectrum with maximum energy (205 ± 10) keV is detected. The experimental log ft value of 19.0 and known spin change $\Delta I = 3$ indicate a 3rd forbidden transition. No evidence of a reported 1.0 MeV β-transition is found. A new decay scheme is proposed and agrees with the results of independent investigators on the β^- and β^+ activity of Cs^{138} and Pr^{138} respectively. The partial half-life of the electron capture branch is found to be $(1.64 \pm 0.06) \times 10^{11}$ years, and of the β-branch $(4.1 \pm 0.7) \times 10^{11}$ years and $(3.5 \pm 0.3) \times 10^{11}$ years measured by direct counting of the β-rays and by calculation of the total counts due to the 0.81 MeV γ-ray respectively. 70% of the total disintegrations are estimated to proceed by electron capture and 30% by β emission. A.

539.163.2

4670. ATTENUATION OF Am^{241} α–γ ANGULAR CORRELATION IN LIQUID FILM SOURCES. V.E.Krohn, T.B.Novey and S.Raboy.
Phys. Rev., Vol. 105, No. 1, 234-7 (Jan. 1, 1957).

Measurements of the alpha–gamma correlation of Am^{241} have been carried out for liquid sources. Attenuation of the angular correlation pattern with time was measured and λ_2 was determined for HCl, H_2SO_4, and $HClO_4$ media. For HCl and $HClO_4$ $\lambda_2 = 13.5 \pm 2$ per μsec and for H_2SO_4 $\lambda_2 = 21 \pm 2$ per μsec. These attenuation constants were independent of the concentration. The extrapolated value of A_2 has been compared with a prediction based on the rotational model. A.

539.163.2

4671. DECAY OF Ir^{192}. V.Shiel, L.D.Wyly and C.H.Braden.
Phys. Rev., Vol. 105, No. 5, 1521-4 (March 1, 1957).

Gamma–gamma angular correlation experiments have been performed for the 604-316, 588-613, and 468-316 keV cascades in Pt^{192} and the 485-206 keV cascade in Os^{192}. The data are consistent

with a spin of 3 for the 690 keV level in Os^{192} and the 921 and 1201 keV levels in Pt^{192}. The assignment of spin 3 to the 1201 keV level in Pt^{192} requires an admixture of about 8.5% M1 radiation in the 588 keV transition. Spin 5 for the ground state of Ir^{192} is indicated. A.

539.163.2

4672. DECAY PROPERTIES OF 74-SECOND Ag^{111m}.
U.L.Schindewolf, J.W.Winchester and C.D.Coryell.
Phys. Rev., Vol. 105, No. 6, 1763-5 (March 15, 1957).

Silver activities were separated by a rapid elution with concentrated HCl from an anion-exchange column containing 22.5 min Pd^{111} as $PdCl_6^=$ from deuteron-bombarded Pd^{110}. The decay of Ag^{111m} was observed with a half-life of 74 ± 3 sec, and its radiations were compared by aluminium absorption with those of 40 sec Ag^{109m}. Conversion electrons and X-rays are seen, with less than 0.1% β-decay to Cd^{111}. Search for 49 min Cd^{111m} showed less than 0.01% β-decay to this species. Essentially all of the decay of Pd^{111} goes to Ag^{111m}. A.

539.164.2 : 539.172

4673. ELECTRON EFFECTS ON BARRIER PENETRATION.
V.A.Erma.
Phys. Rev., Vol. 105, No. 6, 1784-7 (March 15, 1957).

The effect of the surrounding electrons on the nuclear barrier penetration probability is considered. The nuclear potential is replaced by the Fermi—Thomas potential for heavy atoms, and by a potential derived from a constant electron-density model for very light atoms. The theory is applied to the evaluation of alpha-decay periods and of the rates of thermonuclear reactions including the d—d reaction. It is shown that to first order the electron effect can be considered as an increase in the "effective energy" of the alpha particle. Numerical computations were made for the cases of the alpha-decay of Rn^{222}, Po^{212}, Sm^{147}, and for the rates of the d—d and the $p+N^{14}$ reactions. A.

539.165 : 539.166

4674. ANGULAR CORRELATION MEASUREMENTS IN THE DECAY OF Hg^{197}. H.H.Coburn, J.V.Kane and S.Frankel.
Phys. Rev., Vol. 105, No. 4, 1293-300 (Feb. 15, 1957).

Measurements of the e_K^-, e_L^-, and $e_{M^-} - \gamma$, $e_{L+M^-} - e_K^-$ and e_L^-, and $\gamma-\gamma$ angular correlation coefficients in sources of different chemical compositions in the 13/2(M4)5/2(E2)1/2 cascade of 24 hr Hg^{197} have been carried out in a study of the effects of extranuclear fields on angular correlation measurements. Measurement of the $\gamma-\gamma$ correlation in dilute mercuric nitrate solutions yields $A_2 = 0.214 \pm 0.037$ in agreement with the theoretical value for this cascade. Solid $Hg(NO_3)_2$ sources show an attenuation of the $\gamma-\gamma$ coefficient, $g_2 = 0.51 \pm 0.16$. The $e_K^- - \gamma$ coefficients are attenuated relative to the theoretical coefficients by the factor $g_2 = 0.47 \pm 0.03$. The role of the effects of internal conversion on the attenuation of correlation coefficients is examined in terms of these measurements and those of other authors on Hg^{197}, Hg^{199}, and Ta^{181}. A.

539.165

4675. POSITRON SPECTRUM OF O^{15}.
O.C.Kistner, A.Schwarzschild, B.M.Rustad and D.E.Alburger.
Phys. Rev., Vol. 105, No. 4, 1339-41 (Feb. 15, 1957).

This has been investigated with two iron-free magnetic spectrometers. One measurement, performed with an intermediate-image spectrometer and a solid source, gave an end-point energy of 1.723 ± 0.005 MeV. The other measurement, performed with a thin lens spectrometer and a gaseous source, gave an end-point energy of 1.736 ± 0.010 MeV. These values, which are approximately 0.050 MeV higher than the only previously reported spectrometer measurement, are in good agreement with the end point predicted from $N^{15}(p,n)O^{15}$ threshold determinations. The ft value calculated from an average end-point energy of 1.733 ± 0.005 MeV derived from the beta spectra and the (p,n) threshold measurements is 4280 ± 100 sec. This new value brings the O^{15} decay into good agreement with the B—x analysis of the 0—0 spin change and the "doubly closed shell plus or minus one nucleon" beta transitions. A.

539.165.08

4676. DETERMINATION OF THE MAXIMUM ENERGY OF β-SPECTRA BY THE METHOD OF ABSORPTION IN GOLD (FORRO'S METHOD). Y.Robinet, L.Winand and G.Guében.
Bull. Soc. Roy. Sci. Liège, Vol. 24, No. 11-12, 313-25 (Nov.-Dec., 1955). In French.

The absorption coefficient (μ/ρ in cm^2/g) in Au, and E_0, the β-spectrum end-point, are found to obey, to within 3%, an experimental relation $E_0(MeV) = 11.84\ (\mu/\rho)^{-0.769}$ for the energy range 0.7 to 2.3 MeV. The difference between this and Forro's expression (see Abstr. 1642, 1954) is attributed to differences in geometry. Using this method successful analysis of the complex β-spectrum of Dy^{165} was obtained. M.A.Grace

539.166

4677. POLARIZATION OF γ RAYS IN Ta^{181}. P.H.Stelson and F.K.McGowan.
Phys. Rev., Vol. 105, No. 4, 1346-9 (Feb. 15, 1957).

Directional correlation measurements of the γ-rays following the decay of Hf^{181} to excited states in Ta^{181} have indicated two possible spin assignments for the 482 and 615 keV states. Calculation of the expected polarization of the 482 keV γ-rays in the 133-482 keV decay showed that this property was quite different for the two spin assignments. For the spin assignment 482, $9/2^+$, and 615, $5/2^+$ the calculated value of p is 1.10 where $p \equiv W(90^0, 90^0)/W(90^0, 0^0)$ in the notation of Biedenharn and Rose. For the spin assignment 482, $5/2^+$, and 615, $1/2^+$ the value of p is 0.67. The experimental value for liquid HfF_4 source is (0.71 ± 0.05). To check on possible systematic errors, measurements were also made with a dry HfF_4 source for which one expects an attenuated value for p of 0.91. The experimental value is (0.88 ± 0.05). It is concluded that the correct spin assignments are 482, $5/2^+$, and 615, $1/2^+$. Reduced γ-ray transition probabilities are obtained. The collective model of the nucleus is used to interpret the low-lying states of Ta^{181}. A.

539.166.2 : 539.172.4

4678. EMISSION OF γ-QUANTA BY NUCLEI OF I, Rh AND Co RESULTING FROM CAPTURE OF THERMAL NEUTRONS.
I.V.Estulin, L.F.Kalinkin and A.S.Melioranskii.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 886-7 (1956). In Russian.

Energies and absolute intensities of γ-quanta, with energies from 50 to 600 keV, were measured using a NaI(Tl) spectrometer. The nucleus of I emits a line of energy E = 135 keV and intensity n = 30 γ-quanta for 100 neutron captures. γ-ray spectrum of the Rh nucleus consists of four lines (E_1 = 217, E_2 = 176, E_3 = 133, E_4 = 96 keV and n_1 = 9.3, n_2 = 18, n_3 = 8, n_4 = 16), and that of Co of two lines (E_1 = 276, E_2 = 226 keV and n = 20). Z.Krasucki

539.166.74

4679. ELASTIC SCATTERING OF γ-RAYS OF ENERGIES UP TO 120 MeV BY PROTONS. B.B.Govorkov, V.I.Gol'danskiĭ, O.A.Karpukhin, A.V.Kutsenko and V.V.Pavlovskaya.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 5, 988-9 (1956). In Russian.

Gamma rays from synchrotron electrons are registered in a telescope of scintillation counters. The results show some backward peaking, and are slightly inconsistent with the calculation carried out by Powell assuming a static magnetic moment. G.E.Brown

539.166.74

4680. NUCLEAR RESONANT SCATTERING OF GAMMA RAYS IN ^{199}Hg. V.Knapp.
Proc. Phys. Soc. A, Vol. 70, Pt 2, 142-5 (Feb., 1957).

The resonant nuclear scattering of the 209 keV gamma-ray in Hg^{199} has been studied by the high-speed rotor technique (Abstr. 2990/1951, 2721/1953), and the decrease of scattering at speeds above the optimum has been observed. From the measured ratio of resonant scattering to Rayleigh scattering, and with allowance for internal-conversion transitions, the mean life of the 209 keV level is found to be $(7.8 \pm 1.2) \times 10^{-11}$ sec. A.

539.166.75

4681. GAMMA ATTENUATION WITH BUILDUP IN LEAD AND IRON. D.G.Chappell.
Nucleonics, Vol. 15, No. 1, 52-3 (Jan., 1957).

Nomograms are given.

539.166.75

4682. ABSORPTION OF BREMSSTRAHLUNG OF A BETATRON IN A TWO-LAYER ABSORBER. A.N.Orlov and G.V.Fedorov.
Zh. tekh. Fiz., Vol. 26, No. 9, 1991-3 (1956). In Russian.

Intensity of the radiation passing through an absorber, consisting of two plane layers of different materials, bombarded by a perpendicular beam of monochromatic γ-rays of infinite extent, is calculated. The contributions of the Compton effect, the photoeffect and pair production are taken into account. Some practical cases are considered and compared with experimental data; the observed discrepancies may be due to the effect of multiple scattering which is neglected in the calculation. G.Martelli

539.166.83

4683. INTERNAL CONVERSION ELECTRONS FOLLOWING COULOMB EXCITATION OF HIGHLY DEFORMED NUCLEI.
E.M.Bernstein and H.W.Lewis.

Phys. Rev., Vol. 105, No. 5, 1524-8 (March 1, 1957).

A study of internal conversion electrons following Coulomb excitation by alpha-particles of a number of nuclei in the rare earth region has been made. In four cases, Eu^{153}, Ho^{165}, Lu^{175}, and Ta^{181}, it was possible to obtain sufficient experimental data to make a fairly complete comparison with the predictions of the simple rotational model of Bohr and Mottelson. Within the large experimental uncertainties the data were consistent with the theory. First rotational state transitions have been studied in Gd^{155}, Gd^{157}, Re^{185}, Re^{187}, Ir^{191}, and Ir^{193}. In addition transitions of 73 and 83 keV were observed in Ir^{191} and Ir^{193} respectively. The data are consistent with the assignment of the transitions as coming from levels of these energies. A.

539.166.83

4684. RESEARCH ON THE SPECTRUM OF THE CONVERSION ELECTRONS OF ACTINIUM X BY MEANS OF THE PHOTOGRAPHIC METHOD. C.Matiasek.
S.B.Österr. Akad. Wiss. IIa, Vol. 164, No. 5-7, 161-8 (1955). In German.

By observing the electron tracks associated with actinium stars in Ilford G.5 emulsion and counting the total number of grains in each track, the AcX electron conversion spectrum has been obtained. The energies of seven groups have been determined and compared with results from magnetic analysis. An additional group was obtained at 28 keV. Through the observation of electron pairs certain γ-ray cascades could be established. D.J.A.Prowse

539.166.835

4685. ON THE ANNIHILATION OF POSITRONS IN METALS. V.I.Karpman and I.Z.Fisher.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1212-14 (1956). In Russian.

The lifetime of a positron for direct annihilation with a free electron in a metal is calculated and shown to be in good agreement with the experimental data. W.O.Lock

539.166.835

4686. POSITRONIUM FORMATION IN GASES. V.W.Hughes.
J. appl. Phys., Vol. 28, No. 1, 16-22 (Jan., 1957).

The formation of positronium in gases can be investigated by observing the energy spectrum of the annihilation radiation. The increase in positronium formation due to a static electric field has been measured in various gases. For the rare gases the increase has a sigmoid dependence on the ratio of electric field to pressure. The fraction of the positrons that form positronium increases by a maximum factor of 1.5, 1.4 and 2.1 for He, Ne and A, respectively. A similar increase was observed for H_2, D_2 and N_2. No effect of the electric field was found in the polyatomic gases CO_2, CH_4, C_2H_6 and CCl_2F_2, but a small anomalous decrease in positronium formation was seen in SF_6. The increase in positronium formation occurs in the presence of an electric field because low energy positrons, which die by direct annihilation with atomic electrons without positronium formation in the absence of an electric field, can gain energy from the electric field to cross the threshold energy for positronium formation in the gas. A theory based on the Boltzmann equation describes the behaviour of the positrons under the combined influence of the electric field and molecular collisions, and provides the basis for obtaining from the observed data values of the elastic scattering cross-section of positrons by the rare gas atoms. The cross-sections are $0.023\pi a_0^2$, $0.12\pi a_0^2$, and $1.5\pi a_0^2 \pm 25\%$ for He, Ne and A, respectively. Quantitative interpretation for the polyatomic gases is more difficult. A.

539.166.835

4687. RADIATIVE CORRECTIONS TO PAIR ANNIHILATION. I.Harris and L.M.Brown.
Phys. Rev., Vol. 105, No. 5, 1656-61 (March 1, 1957).

The e^6 corrections to the probability of direct two-photon pair annihilation are obtained by applying the substitution law to the Compton scattering radiative corrections. General results are given, as well as low- and high-energy limits. Divergence of the corrected matrix element for small relative velocity, due to failure of the Born approximation, is removed by a more accurate treatment of Coulomb effects based on the Sommerfeld factor. The results are applied to the singlet ground state of positronium, yielding an increase in the lifetime of 0.59%. A.

539.166.835

4688. INTERNAL BREMSSTRAHLUNG IN AN ELECTRIC MONOPOLE $0^+ \rightarrow 0^+$ TRANSITION OF A NUCLEUS. Yu.V.Orlov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1103-5 (1956). In Russian.

Results are presented of a calculation, in Born approximation, of relative probability of internal bremsstrahlung emitted by components of an electron–positron pair in $0^+ \rightarrow 0^+$ transition of a nucleus. Z.Krasucki

539.167 : 550.42

4689. ON THE INFINITE MULTIPLICATION CONSTANT AND THE AGE OF URANIUM MINERALS. P.K.Kuroda.
J. chem. Phys., Vol. 25, No. 6, 1295-6 (Dec., 1956).

See Abstr. 2616 (1956). This constant has been calculated for 20 samples of uranite, pitchblende etc. and the value of the constant decreases for the older minerals. It is suggested that this is related to the quantity of rare earth elements present in the sample owing to the extremely large neutron absorption cross-section of certain rare earths. J.M.Hough

NUCLEAR REACTIONS 539.17

539.172

4690. ON THE POSSIBILITY OF THE UTILIZATION OF ATOMIC ENERGY WITHOUT CHAIN REACTION. K.Simonyi.
Acta phys. Hungar., Vol. 6, No. 1, 157-60 (1956). In German.

The possible use of high-efficiency particle accelerators as a source of power is considered, in particular a condenser discharge through a mixture of deuterium and tritium. A.O.Stanesby

539.172

4691. ANTINEUTRINO DISINTEGRATION OF THE DEUTERON. J.Weneser.
Phys. Rev., Vol. 105, No. 4, 1335-7 (Feb. 15, 1957).

The cross-section for the antineutrino disintegration of the deuteron, $\bar{\nu} + d \rightarrow n + n + e^+$, is considered. The only important contribution to the cross-section arises from a ^1S final nucleon state, and only the tensor part of the beta-interaction is effective. The matrix element can be evaluated by the effective-range formulation well known from calculations of the photomagnetic disintegration of the deuteron. The cross-section is evaluated for three antineutrino energies: 5.5, 8.5, 13.5 MeV. The results for this process would be the same if the neutrino were a Majorana particle. A.

539.172

4692. COLLECTIVE MOTIONS AND NUCLEAR REACTIONS. M.Moshinsky.
Rev. Mexicana Fís., Vol. 5, No. 1-2, 1-42 (Jan.-April, 1956). In Spanish.

The effect of collective motions, in the sense of A.Bohr, on nuclear reactions is discussed. The perturbation treatment of the inelastic scattering of nucleons by collective motions is not valid in the physically interesting cases of resonance, when a Tamm–Dancoff approach is suitable and leads for the interaction of the nucleus with the surface to results in agreement with the optical model. A somewhat similar procedure could lead to a formalism which allows an exact description of the phenomenon. L.Pincherle

539.172

4693. SELECTION RULES FOR THE "SENIORITY" QUANTUM NUMBER IN NUCLEAR REACTIONS. V.G.Neudachin.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 891 (1956). In Russian.

Three rules are given and possible experiments to verify them are briefly discussed. W.O.Lock

539.172 : 539.164.2

ELECTRON EFFECTS ON NUCLEAR BARRIER PENETRATION IN THERMONUCLEAR REACTIONS. See Abstr. 4673

539.172 : 537.591.8

4694. NUCLEAR DISINTEGRATIONS PRODUCED BY COSMIC RAY PARTICLES IN A HIGH PRESSURE CLOUD CHAMBER. F.W.Bullock.
Proc. Phys. Soc. A, Vol. 70, Pt 2, 134-41 (Feb., 1957).

Cosmic-ray stars produced in argon at 75 atmospheres pressure have been analysed to give size distributions and angular distributions of the prongs. In a discussion of the stars-producing flux entering the chamber, the natural rate of occurrence of interactions in the chamber is compared with rates obtained by other workers. A

539.172

4695. INTERACTIONS OF THE HEAVY NUCLEI OF THE COSMIC RADIATION. P.H.Fowler, R.R.Hillier and C.J.Waddington.
Phil. Mag.(Eighth Ser.), Vol. 2, 293-304 (March, 1957).

317 nuclear interactions produced by the heavy nuclei of the primary cosmic radiation in nuclear emulsions were observed. From a study of these interactions the interaction mean free paths and fragmentation probabilities were found. The interaction mean free paths are in good agreement with those reported previously. The fragmentation probabilities, particularly those for the production of light nuclei, are considerably smaller than those currently accepted. In addition, from a study of the angular distribution of the nuclei emitted from the interactions it is shown that the energies of emission in the C-system of the incident nucleus are greater than those previously accepted and depend on the charge of the primary nucleus. A.

539.172

4696. NEUTRON PRODUCTION BY μ MESONS STOPPED IN SODIUM AND MAGNESIUM. D.R.Jones.
Phys. Rev., Vol. 105, No. 5, 1591-8 (March 1, 1957).

Measurements of the production of neutrons by negative μ-mesons which stop and interact in two materials, sodium and magnesium, are reported. The mean number of neutrons emitted per interaction was found to be 0.6 ± 0.2 for magnesium and 1.0 ± 0.4 for sodium, where the uncertainties include an estimated contribution from systematic sources as well as those of a statistical nature. The data confirm that neutron production in magnesium is less than in lead (multiplicity 1.7 ± 0.3), but show that it is not zero. Neutron production in sodium also is shown to be measurable and probably greater than in magnesium, though less than in lead. In the course of the experiment a value of $(1.18_{-0.14}^{+0.19})$ μsec (statistical) was found for the mean life of negative μ-mesons in sodium. A.

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172 : 539.18

4697. INTERACTION OF FAST π-MESONS WITH NUCLEI. L.P.Kudrin and B.A.Nikol'skiĭ.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 4, 795-8 (1956). In Russian.

A beam of π^--mesons is incident on an emulsion camera of 30 layers, each of thickness 395 μ and diameter 70 mm. Results relate to an energy $E_\pi = 160$ MeV. Of 1185 interactions, 323 relate to inelastic scattering of charged π's. The potential representing the average interaction is evaluated and found to be $V = -(24 \pm 6$ MeV). G.E.Brown

539.172

4698. INTERACTION LENGTHS AND DIFFRACTION SCATTERING OF 4.2 GeV π^--MESONS IN G5 EMULSION. J.O.Clarke and J.V.Major.
Phil. Mag. (Eighth Ser.), Vol. 2, 37-48 (Jan., 1957).

A large block of G5 emulsion has been exposed to the 4.2 GeV π^--meson beam of the Berkeley Bevatron and 120 m of π^--meson track scanned. The total interaction length is found to be (27.1 ± 2.4) cm and the individual interaction lengths for the production of stars and scatters are (38.7 ± 3.5) cm and (90^{+23}_{-15}) cm respectively. The geometrical interaction length is 28.4 cm. Good agreement with diffraction scattering theory is found for the observed angular distribution of the secondaries in the elastic scattering events. A.

539.172

4699. NEGATIVE-PION ACTIVATION OF SILVER. W.Goishi and W.F.Libby.
Phys. Rev., Vol. 104, No. 6, 1717 (Dec. 15, 1956).

The yields of some isotopes of palladium, rhodium, and ruthenium produced by the reaction of π^--mesons with silver were determined radiochemically. These results, together with those from a similar study with bromine, make possible a comparison with the data obtained with photographic plates. The results are consistent with each other within the uncertainties of the experimental data. A.

539.172

4700. INVESTIGATION OF σ-STARS INDUCED BY NEGATIVE π-MESONS. S.A.Azimov, U.G.Gulyamov, E.A.Zamchalova, M.Nizametdinova, M.I.Podgoretskiĭ and A.Yuldashev.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 756-61 (1956). In Russian.

Properties of σ-stars created by π-mesons stopped in an emulsion stack were investigated. Distribution of the number of prongs of 938 analysed σ-stars are presented as well as data on distribution of the energy of secondary particles. The obtained energy spectrum is compared with data for stars produced by K^--mesons. A.

539.172

4701. TOTAL INELASTIC INTERACTION CROSS-SECTION OF 225 ± 10 MeV π^--MESONS WITH THE NUCLEI C, Al, Cu, Sn AND Pb. V.G.Ivanov, V.T.Osipenkov, N.I.Petrov and V.A.Rusakov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1097 (1956). In Russian.

Mesons were registered by a telescope of three scintillation counters. Cross-sections are slightly above geometrical, calculated with a nuclear radius $R = 1.4\ A^{1/3} \times 10^{-13}$ cm. G.E.Brown

539.172

4702. ELECTRON SCATTERING FROM NEIGHBORING NUCLEI. B.Hahn, R.Hofstadter and D.G.Ravenhall.
Phys. Rev., Vol. 105, No. 4, 1353-5 (Feb. 15, 1957).

A new method of measuring small variations of the charge distributions of neighbouring nuclei, such as isotopes and isotones, has been developed. The method is based on a determination of the ratio of electron scattering cross-sections near the diffraction dips. Experimental results are given for the combinations Ni^{58}, Ni^{60} and Fe^{56}, Ni^{58}. Sample theoretical interpretations are presented. A.

539.172.11

4703. INVESTIGATION OF THE ENERGY SPECTRUM OF NEUTRONS FROM A Po-Be SOURCE WITH THE PHOTOGRAPHIC EMULSION METHOD. L.Medveczky.
Acta phys. Hungar., Vol. 6, No. 2, 261-72 (1956).

Thick-layered Be was bombarded with α-particles of a small-diameter Po preparation. The distribution of neutron-emission energy associated with the $Be^9(\alpha,n)C^{12}$ nuclear process was determined by the measurement of recoil-proton tracks incident in the nuclear emulsion. The energy spectrum obtained by the measurement of more than 12000 tracks showed three maxima (1.3, 4.4, 6.9 MeV) and the observed upper limit of neutron energy was 10.7 MeV. The distribution of energy observed showed considerable disagreement with results known from literature. This can be accounted for by the fact that the number of measurements contributing to the present result exceeds by far the number of measurements carried out by other authors. Furthermore, the divergence of irradiation geometry offers a very favourable opportunity of observation when a source of small diameter is used. A.

539.172.11

4704. RESOLVED NEUTRONS FROM THE Be(α,n) REACTION. J.R.Risser, J.E.Price and C.M.Class.
Phys. Rev., Vol. 105, No. 4, 1288-93 (Feb. 15, 1957).

Angular distributions and 0^0 excitation curves have been taken of resolved ground-state and first-excited-state neutron groups from the reactions $Be^9(\alpha,n)C^{12}$ (Q = 5.71 MeV) and $Be^9(\alpha,n)C^{12*}$ (Q = 1.28 MeV). For the ground-state neutron group, angular distributions were taken at bombarding energies from 2 to 5 MeV, and a 0^0 excitation curve from 1.7 to 4.8 MeV. For the neutron group to the first excited state of C^{12}, angular distributions were taken in the range 4 to 5 MeV, and a 0^0 excitation curve from 3.1 to 4.8 MeV. Attempts were made to fit the ground-state neutron angular distributions above 4 MeV using compound-nucleus theory. A.

539.172.11

4705. ANGULAR DISTRIBUTIONS OF PROTONS FROM THE ALPHA-PARTICLE BOMBARDMENT OF B^{10}, Al^{27}, AND P^{31}. P.von Herrmann and G.F.Pieper.
Phys. Rev., Vol. 105, No. 5, 1556-62 (March 1, 1957).

Angular distribution measurements have been carried out on the protons corresponding to the ground state transition in the $B^{10}(\alpha,p)C^{13}$ reaction at bombarding energies of 8.1, 7.0, and 4.9 MeV, on the protons corresponding to the ground state and first-excited state transitions in the $Al^{27}(\alpha,p)Si^{30}$ reaction at bombarding energies of 8.1 and 7.1 MeV, and on the protons corresponding to the ground state transition in the $P^{31}(\alpha,p)S^{34}$ reaction at bombarding energies of 8.1 and 7.0 MeV. According to rather qualitative criteria concerning the changes in the shapes of the distributions with bombarding energy, the Al results appear to be interpretable in terms of a compound nucleus process, while the B and P results indicate the possibility of a contribution from a direct interaction process. Some discussion is given concerning the possibility of applying a direct interaction process like that of Austern, Butler, and McManus to such alpha-particle-induced reactions. A.

539.172.11

4706. ALPHA-PARTICLE BOMBARDMENT OF MAGNESIUM ISOTOPES. H.G.Graetzer and A.B.Robbins.
Phys. Rev., Vol. 105, No. 5, 1570-2 (March 1, 1957).

Energy levels in three aluminium isotopes have been observed with alpha-particle bombardment of magnesium isotope targets. Protons from the reaction were observed with a proportional counter.

By using an aluminium foil changer before the counter and recording only those protons near the end of their range, an energy resolution from 4 to 8% was obtained in the various runs. The ground-state Q values were calculated by comparison to the $Mg^{24}(\alpha,p)Al^{27}$ ground-state group using the known Q value for the inverse reaction. The ground-state Q values were found to be -1.29 ± 0.04 MeV for $Mg^{25}(\alpha,p)Al^{28}$, and -2.90 ± 0.04 MeV for $Mg^{26}(\alpha,p)Al^{29}$. Proton groups were found corresponding to excited states in Al^{27} at 0.85, 1.06, 2.17, and 2.64 MeV; in Al^{28} at 1.00, 1.57, 2.18, 2.54, and 2.96 MeV; in Al^{29} at 1.69 MeV. The mass value of Al^{29} was calculated to be 28.989 72 ± 0.000 06 a.m.u. A.

539.172.11 : 539.152.2

4707. ANALYSIS OF ANGULAR DISTRIBUTIONS IN THE $C^{13}(\alpha,n)O^{16}$ REACTION. J.P.Schiffer, A.A.Kraus, Jr and J.R.Risser.
Phys. Rev., Vol. 105, No. 6, 1811-15 (March 15, 1957).

From the study of the angular distributions in the $C^{13}(\alpha,n)O^{16}$ reaction, angular momentum assignments have been obtained for thirteen states of the compound nucleus, O^{17}. Some relative parity assignments were made on the basis of interference effects. A.

539.172.13

4708. POLARIZATION OF LOW ENERGY PROTONS SCATTERED BY CARBON. B.V.Gavrilovskiĭ, V.Ya.Golovnya, K.V.Karadzhev, A.P.Klyucharev and V.I.Man'ko.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 1, 59-62 (1956). In Russian.

A double scattering experiment using emulsions and incident proton energies between 1.9 and 2.4 MeV in steps of 0.1 MeV. Results agree well with the phase shift analysis of Jackson et al. (Abstr. 2611/1953). W.O.Lock

539.172.13

4709. POLARIZATION OF PROTONS SCATTERED ELASTICALLY BY NUCLEI OF C^{12}. P.V.Sorokin and A.Ya.Taranov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 1, 82-4 (1956). In Russian.

Experimental results are presented which confirm the dependence of polarization P on energy of protons calculated by I.T.Dyatlov and L.N.Rozentsveĭg (1955). Z.Krasucki

539.172.13

4710. ^{8}Li EMISSION FROM HEAVY ELEMENT DISINTEGRATIONS PRODUCED BY 5.7 BeV PROTONS. S.J.Goldsack, W.O.Lock and B.A.Munir.
Phil. Mag. (Eighth Ser.), Vol. 2, 149-56 (Feb., 1957).

A stack of Ilford G5 emulsions exposed to the 5.7 BeV proton beam of the Berkeley Bevatron has been searched for dinsintegrations of silver and bromine nuclei with ejected Li^8 fragments, and 91 examples found. The experimental results can be explained qualitatively by assuming that most of the fragments from the stars with 12 or more black prongs are ejected as part of the evaporation process but a few of the fragments from the smaller stars (less than 12 black prongs) are ejected during the initial stages of the collision. A.

539.172.13

4711. QUASI-ELASTIC COLLISIONS OF 925 MeV PROTONS. J.G.McEwen, W.M.Gibson and P.J.Duke.
Phil. Mag. (Eighth Ser.), Vol. 2, 231-44 (Feb., 1957).

Quasi-elastic collisions of protons with protons bound in nuclei have been examined in G5 emulsions exposed to 925 MeV protons from the Birmingham synchrotron. The directions of the secondary particles have been used to obtain values for two components of the momentum of the bound protons. The observed momentum distribution may be described approximately by the function $\exp(-K/7) + 0.05 \exp(-K/40)$, where K is the energy of the bound proton in MeV. The results show that $(2.2 \pm 0.3)\%$ of all nuclear reactions in the emulsion are quasi-elastic collisions with angle greater than 30^0 in the C-system of the two protons. This figure agrees with a calculation based on a semitransparent nuclear model. The calculation indicates that such events contribute about 5% of the interactions with the light nuclei and about 0.7% of those with the heavy nuclei in the emulsion. A.

539.172.13

4712. DIFFERENTIAL CROSS SECTIONS FOR THE SCATTERING OF MEDIUM ENERGY PROTONS ON CARBON. R.W.Peelle.
Phys. Rev., Vol. 105, No. 4, 1311-23 (Feb. 15, 1957).

Extensive experimental results are presented showing the variation with energy of the absolute angular distributions for the elastic and inelastic scattering of medium energy protons on carbon. For the scattering with Q = 0 and Q = −4.4 MeV, angular distributions between 20^0 and 170^0 were obtained for eleven incident proton energies spaced between 14.0 MeV and 19.4 MeV. Distributions for scattering leading to the excitation of the 7.7 MeV and 9.6 MeV states of C^{12} were measured at energies of 16.7, 17.8, and 18.9 MeV. The experimental results are discussed qualitatively in their relation to the predictions of the theories of nuclear reactions. The elastic scattering cross-sections are roughly what one might expect from the complex potential theory, but no numerical comparisons have been made. The predominant inelastic scattering is forward, though the angular distributions corresponding to the three levels studied do not resemble each other. In no single case is one of these distributions symmetrical about 90^0. The simple Bessel-function distributions of the first-order direct interaction theory do not agree well with the data, but only the scattering leading to the 4.4 MeV level of C^{12} is in apparently complete disagreement. Experimental differential cross-sections as a function of energy are also presented for the scattering of protons on hydrogen near 90^0 (centre-of-mass system). A.

539.172.13

4713. INELASTIC SCATTERING OF 12-MeV PROTONS ON LITHIUM, CARBON, MAGNESIUM, AND SILICON. H.E.Conzett.
Phys. Rev., Vol. 105, No. 4, 1324-31 (Feb. 15, 1957).

The angular distributions of protons from the reactions $Li^7(p,p')Li^{7*}$ (Q = −4.61 MeV), $C^{12}(p,p')C^{12*}$ (Q = −4.43 MeV), $Mg^{24}(p,p')Mg^{24*}$ (Q = −1.36 MeV), and $Si^{28}(p,p')Si^{28*}$ (Q = −1.78 MeV) have been measured, and the cross-sections for the reactions have been obtained. The lithium distribution has been analysed in terms of (a) inelastic scattering proceeding through formation and decay of the compound nucleus, and (b) direct inelastic scattering of the Austern, Butler, McManus theory. An assignment of $J = 5/2^-$ to the 4.61 MeV level of Li^7 is consistent with all the experimental evidence to date; however, the intermediate coupling shell model prediction of $7/2^-$ should not be ruled out completely. The carbon, magnesium, and silicon distributions indicate that the statistical theory of the compound nucleus does not apply and, also, that the direct-interaction type of scattering is negligible. It appears that the reactions involving these nuclei proceed through only a few or several levels of the intermediate nuclei. For each reaction, the cross-section has been compared with estimates of the cross-sections for formation of the compound nucleus. The results are in qualitative agreement with the theory of decay of the compound nucleus through competing channels. A.

539.172.13

4714. ANOMALOUS INELASTIC SCATTERING OF 23-MeV PROTONS BY HEAVY ELEMENTS. B.L.Cohen.
Phys. Rev., Vol. 105, No. 5, 1549-55 (March 1, 1957).

Measurements of energy distributions from inelastic scattering of 23 MeV protons by heavy elements indicate the presence of very strong, apparently monoenergetic groups. The energies, cross-sections, and angular distributions of these proton groups vary slowly and regularly with atomic number. For $Z > 40$, there is little difference between even and odd elements, or across closed shells; this complicates any explanation of these levels by single-particle excitation, and this and other factors make collective-motion explanations difficult. A.

539.172.13 : 539.166.2

4715. PROTON BREMSSTRAHLUNG. B.Kurşunoğlu.
Phys. Rev., Vol. 105, No. 6, 1846-53 (March 15, 1957).

The differential cross-section for the production of gamma-rays from the bremsstrahlung of protons of 30 to 140 MeV kinetic energy in the centre-of-mass system, is calculated. An energy-dependent complex square well is used to represent the nuclear interaction. The complexity of the potential enhances gamma-ray production. Furthermore, the theory predicts a low intensity for high-energy gamma-rays. It is also found that the continuous spectrum of radiation is closed between very low-frequency and high-energy gamma-rays of energy just below the incident proton kinetic energy. By using the experimental information, a qualitative result about the energy dependence of the imaginary part of the potential is obtained in comparable form with those used by other people. A.

539.172.13 : 537.591.15

OBSERVATION OF HIGH-ENERGY PROTON–PROTON COLLISIONS IN PHOTOGRAPHIC EMULSIONS. See Abstr. 4513

539.172.13 : 539.18

MESON PRODUCTION BY THE REACTIONS OF 660 MeV PROTONS WITH VARIOUS NUCLIDES. See Abstr. 3735

539.172.13

4716. ANGULAR DISTRIBUTIONS WITH HIGH ENERGY RESOLUTION: EXPERIMENTAL METHOD. K.Ahnlund.
Ark. Fys., Vol. 10, Paper 27, 373-85 (1956).

The apparatus comprised a Cockcroft–Walton accelerator and analysing magnet, target chamber and rotatable double-focusing magnetic heavy-particle spectrometer; detection was by nuclear emulsions. Experimental techniques are described briefly.
A.O.Stanesby

539.172.13

4717. ANGULAR DISTRIBUTIONS WITH HIGH ENERGY RESOLUTION: LONG-RANGE GROUPS FROM $O^{18}(d,p)O^{19}$. K.Ahnlund.
Ark. Fys., Vol. 10, Paper 31, 425-30 (1956).

The angular distributions of the two proton groups from this reaction were measured and are given graphically. The apparatus and techniques used are described in an earlier paper (see preceding abstract).
A.O.Stanesby

539.172.13

4718. 870-keV LEVEL IN O^{17}. F.S.Mozer and F.B.Hagedorn.
Phys. Rev., Vol. 105, No. 4, 1270-1 (Feb. 15, 1957).

The $O^{16}(d,p)O^{17*}$ reaction has been studied at an incident deuteron energy of 999.0 keV and a laboratory scattering angle of 135° to investigate the possible existence of a doublet level in O^{17} near 870 keV. No evidence of such a doublet was observed. By accurate determination of target surface contamination and instrument calibration constants, the Q value for this reaction was found to be 1049 ± 2.2 keV.
A.

539.172.13

4719. DEUTERON-INDUCED REACTIONS LEADING TO N^{16}. N.A.Bostrom, E.L.Hudspeth and I.L.Morgan.
Phys. Rev., Vol. 105, No. 5, 1545-8 (March 1, 1957).

The cross-sections for the reactions $O^{18}(d,\alpha)N^{16}$ and $N^{15}(d,p)N^{16}$ have been determined and the excitation functions obtained for deuteron bombarding energies of 0.30 to 3.00 MeV. At a bombarding energy of 1.16 MeV, the $O^{18}(d,\alpha)N^{16}$ cross-section is 44 mb, and the $N^{15}(d,p)N^{16}$ cross-section is 280 mb. Resonances in the $O^{18}(d,\alpha)N^{16}$ excitation function occur at values which correspond to excited levels in F^{20} at 13.69, 13,91, 14.27, and 14.94 MeV. The rapidly rising smooth excitation curve for the reaction $N^{15}(d,p)N^{16}$ indicates a barrier penetration with some evidence for weak resonances corresponding to excited states in O^{17} at 15.18 MeV and 15.69 MeV. Attempts were made to detect the reaction $C^{14}(d,\gamma)N^{16}$; it was possible to set only an upper limit of 0.1 mb on the cross-section for this reaction at a bombarding energy of 1.16 MeV. Scintillation spectrometry of the N^{16} decay shows the ratio of the intensities of the 6.133 and 7.10 MeV γ-rays to be 1 : 0.81.
A.

539.172.13

4720. ANALYSIS OF THE $B^{11}(d,n)C^{12}$ REACTION BY NUCLEAR STRIPPING. G.E.Owen and L.Madansky.
Phys. Rev., Vol. 105, No. 6, 1766-71 (March 15, 1957).

The ordinary deuteron stripping theory has been extended to include the effect of heavy-particle stripping by the antisymmetrization of the final-state neutron wave function. When one uses the Born approximation, this extension gives both the deuteron and heavy-particle stripping amplitudes, together with a positive interference term. Good qualitative agreement with experiment in the energy range 0.6-4.7 MeV is obtained using an interaction radius of 4.5×10^{-13} cm. The ratio of the amplitudes of heavy-particles and deuteron stripping decreases below the Coulomb barrier, and is relatively constant above the Coulomb barrier.
A.

539.172.13 : 539.152.1

4721. MAGNETIC ANALYSIS OF TRITONS AND ALPHA PARTICLES EMITTED FROM THE DEUTERON BOMBARDMENT OF TEFLON. F.A.El Bedewi and I.Hussein.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 233-40 (April, 1957).

The energy spectra for particles emitted from the $F^{19}(d,t)F^{18}$ and $C^{12}(d,\alpha)B^{10}$ reactions have been measured by magnetic analysis. The mean energy of the incident deuterons is 8.9 MeV. The energy levels of F^{18} are determined at 0.94 ± 0.02 MeV and 1.07 ± 0.02 MeV. The latter level is found to have T = 1. The energy levels of B^{10} are only observed at 0.72 MeV and 2.14 MeV. The absence of an alpha-particle group corresponding to a level at 1.74 MeV, characterized by T = 1, is good evidence for the operation of the isobaric spin selection rule. Angular distributions of these triton and alpha-particle groups are presented. The triton distributions are fitted to theoretical pick-up curves. The angular momenta carried away by the picked-up neutron leaving the nucleus F^{18} at the ground, 0.94 MeV and 1.07 MeV states are found to be 0, 1 and 0 respectively.
A.

539.172.13

4722. NUMERICAL CALCULATION OF NON-COULOMB STRIPPING CROSS-SECTIONS. H.A.Enge and A.Graue.
Rev. sci. Instrum., Vol. 27, No. 12, 1078-9 (Dec., 1956).

Certain nomograms and tables have been prepared to aid the calculation of curves for angular distributions of (d,p) reactions according to Butler's stripping theory. A graph of the "deuteron factor" versus the internal wave-number in the deuteron is given.
D.J.A.Prowse

539.172.13

4723. EXCITATION FUNCTION OF THE REACTION $Si^{28}(d,p)Si^{29}$. Yu.A.Nemilov and V.F.Litvin.
Zh. éksper, teor. Fiz., Vol. 31, No. 4(10), 719-20 (1956). In Russian.

This is measured for incident deuteron energies 1.75 - 4.75 MeV.
G.E.Brown

539.172.13

4724. EFFECT OF THE FINITE MASS OF THE NUCLEAR TARGET ON THE ANGULAR DISTRIBUTION OF THE PRODUCTS OF THE (dp) AND (dn) REACTIONS. D.P.Grechukhin.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 895-7 (1956). In Russian.

The work of Butler (Abstr. 8973/1951) is extended to the case of a finite nuclear mass. Correcting the experimental data for this factor leads to larger values of the "interaction radius" and to better agreement between theory and experiment.
W.O.Lock

539.172.13

4725. NUCLEAR INTERACTION OF 220 MeV DEUTERONS. L.P.Solov'eva.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1086-8 (1956). In Russian.

Stars formed by the deuterons in nuclear emulsions are studied, and the energy spectrum and angular distribution of the resultant protons are given. Both stripped protons and protons from nuclear cascade processes are found.
G.E.Brown

539.172.13 : 539.152.1

STUDY OF THE $Be^9(d,p)Be^{10}$ AND $Be^9(d,He^4)Li^7$ REACTIONS. See Abstr. 4625

539.172.13

4726. THERMONUCLEAR REACTION RATES. W.B.Thompson.
Proc. Phys. Soc. B., Vol. 70, Pt 1, 1-5 (Jan., 1957).

It is shown that the thermonuclear reaction rate between two gases in thermal equilibrium and of densities n_1 and n_2 nuclei per unit volume can be written as $n_1 n_2 \langle \sigma v \rangle$, where $\langle \sigma v \rangle$ is a suitable average of the product of the reaction cross-section and relative velocity, and for any reaction is a function of temperature alone. These functions are given for a number of exoergic reactions between light nuclei.
A.

539.172.3

4727. THE RATIO OF DEUTERONS TO PROTONS IN PHOTO-NUCLEAR REACTIONS DETERMINED BY THE METHOD OF GRAIN-COUNTING. B.Forkman.
Ark. Fys., Vol. 11, Paper 17, 265-75 (1956).

An investigation has been made into the usefulness of the grain-counting method for identification of short tracks. Efforts have been made to separate deuterons from protons by grain-counting in the last 40 μ of the track. The protons and deuterons were obtained by photodisintegration of metals by bremsstrahlung of 30 MeV maximum energy. At the same time the photo-deuteron yield has been compared with the photo-proton yield from cobalt and copper. No marked difference in the ratio, $Y(\gamma,d)/Y(\gamma,p)$, was obtained. The ratio observed was 0.22 for cobalt and 0.16 for copper.
A.

539.172.3 : 539.152.2

4728. THE EFFECT OF ISOTOPIC SPIN IMPURITY ON (γ,p) AND (γ,n) CROSS SECTIONS. F.C.Barker and A.K.Mann.
Phil. Mag. (Eighth Ser.), Vol. 2, 5-14 (Jan., 1957).

The presence of small isotopic spin impurity in an excited state of a self-conjugate nucleus can lead to large differences in the neutron and proton emissions from that state. This effect might be expected to be exhibited clearly in reactions involving a T = 1 excited state produced by E1 absorption, e.g. in a giant resonance state of a photonuclear reaction. The photodisintegration data for C^{12} do in fact suggest that the (γ,p) and (γ,n) cross-sections are more dissimilar than can be explained by penetrability considerations. From calculations based on the shell model it is found that, for an excited state approximate to the giant resonance in C^{12}, an isotopic spin admixture of order 1% in intensity is required to fit the observed ratio of total cross-sections. The angular distributions are sensitive to the details of the excited state wave-function; however, if the calculated proton distribution is made to fit the observed

distribution in the simplest way, a neutron distribution not very different from that for the protons is obtained. The photodisintegration of O^{16} and the reactions $B^{10}(\alpha,n)N^{13}$ and $B^{10}(\alpha,p)C^{13}$ are also briefly considered. A.

539.172.3

4729. NUCLEAR SCATTERING OF 50- TO 130-MeV γ RAYS. G.E.Pugh, R.Gomez, D.H.Frisch and G.S.Janes.
Phys. Rev., Vol. 105, No. 3, 982-95 (Feb. 1, 1957).

Using targets of H,D,Li,Be,C,Cu and Sn, the energy distribution of scattered γ-rays has been measured at 45°, 90° and 135°. In first approximation one would expect a scattering cross-section given by the coherent addition of Thomson scattering amplitudes for Z free protons. Important deviations, probably of mesonic origin, are observed above 90 MeV. Below 70 MeV in complex nuclei there is an increase in cross-section which probably results from nuclear resonance scattering. At small angles in the forward direction, large numbers of inelastically scattered γ-rays were observed, which apparently result from inner bremsstrahlung associated with electron pair production. A.

539.172.3

4730. LOW-ENERGY ACTIVATION FUNCTIONS FOR PHOTOFISSION OF U^{238} AND Th^{232}. R.A.Schmitt and R.B.Duffield.
Phys. Rev., Vol. 105, No. 4, 1277-84 (Feb. 15, 1957).

Activation functions for symmetric and asymmetric photofission of U^{238} and Th^{232} have been determined over the energy range 4.5 MeV to 10 MeV. For both elements, the fission yield varied exponentially with betatron energy over the lowest energies covered and the data show the difficulty in establishing experimentally the existence of a threshold for photofission. The symmetric (Cd^{117}) photofission yield relative to the asymmetric (Ba^{139}) yield in U^{238} showed a local maximum of 0.05% at 6 MeV betatron energy, while the corresponding symmetric yield in Th^{232} rose steadily from $< 0.0003\%$ at 6.5 MeV to 0.1% at 12 MeV betatron energy. A.

539.172.3

4731. RELATIVE YIELDS OF NUCLEAR ISOMERS OF Br^{80} PRODUCED BY A (γ,n) REACTION. A.M.King and A.F.Voigt.
Phys. Rev., Vol. 105, No. 4, 1310-11 (Feb. 15, 1957).

The yield ratio, $Br^{81}(\gamma,n)Br^{80}/Br^{81}(\gamma,n)Br^{80m}$, was determined at several energies between 15 MeV and 70 MeV, using bremsstrahlung produced by 70 MeV synchrotron. It was concluded that the yield ratio does not change significantly above 25 MeV, and, consequently, that the corresponding cross-section ratio is also constant. A.

539.172.3

4732. PRODUCTION OF PHOTOSTARS BY BREMSSTRAHLUNG OF 250 TO 500 MeV. V.Z.Peterson and C.E.Roos.
Phys. Rev., Vol. 105, No. 5, 1620-6 (March 1, 1957).

The yield of photostars in nuclear emulsion as a function of bremsstrahlung energy has been found to increase rapidly from 6.8 millibarns per Q (total beam energy/maximum beam energy) at 250 MeV to 22.8 millibarns per Q at 500 MeV, for stars of 2 or more prongs from silver nuclei. The cross-section for silver was derived by averaging the emulsion nuclei (excluding H) in proportion to their atomic weights. The total photodissociation cross-section is estimated to be at most 20% larger due to the addition of one-prong and zero-prong stars. The cross-section per photon is derived by the photon difference method, and is found to be about 30 millibarns per silver nucleus above 300 MeV. This very large cross-section is approximately 100 times the free nucleon total photomeson cross-section. Therefore, photostar production from re-absorption of real pions produced in nuclear matter requires a very short mean-free-path ($\lambda \cong 1 \times 10^3$ cm). A.

539.172.4

4733. SEARCH FOR SUCCESSIVE NEUTRON CAPTURE REACTIONS ON Mg^{26}, Si^{30} AND Cr^{54}. L.P.Roy and L.Yaffe.
Canad. J. Chem., Vol. 35, No. 2, 176-9 (Feb., 1957).

Stable nuclides exposed to intense neutron fluxes may produce second-order reactions by successive capture of two neutrons. This method has been applied in the present work in an attempt to determine the pile neutron capture cross-section of three unstable nuclides, namely: Mg^{27}, Si^{31} and Cr^{55}. A maximum value of 0.04 barn has been obtained for the cross-section of Mg^{27}. Assuming that Si^{32} and Cr^{56} are long-lived, minimal ratios of 600 and 270 years/barn respectively were obtained for $t_{1/2}Si^{32}/\sigma Si^{31}$ and $t_{1/2}Cr^{56}/\sigma Cr^{55}$. A.

539.172.4

4734. TOTAL EFFECTIVE CROSS-SECTIONS FOR INTERACTION OF NEUTRONS WITH Li^6 AND Li^7 NUCLEI IN THE ENERGY RANGE 10-450 KeV. G.V.Gorlov, B.M.Gokhberg, V.M.Morozov and G.A.Otroshchenko.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 6, 963-5 (1956). In Russian.

Counter experiment, with results in agreement with those of Adair (Abstr. 1325/1951) for Li^7 and Johnson et al. (Abstr. 1213/1955) for Li^6. W.O.Lock

539.172.4

4735. AN ESTIMATE OF THE UPPER LIMIT OF THE CROSS-SECTION FOR RADIOACTIVE CAPTURE OF NEUTRONS OF RESONANCE ENERGY (275 keV) BY THE ISOTOPE Li^7. E.A.Koltypin and V.M.Morozov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 2, 331-3 (1956). In Russian.

Given as 0.25 millibarns, determined by comparison with $Li^6(n,t)He^4$ using concentric gaseous counters, the inner (proportional) counter being lined with LiF. The outer (Geiger) counter detected the β's from the Li^8. W.O.Lock

539.172.4

4736. A MEASUREMENT OF THE EFFECTIVE CROSS-SECTION OF THE REACTION Li^6 (n,t) He^4 IN THE NEUTRON ENERGY RANGE 9 TO 700 keV. G.V.Gorlov, B.M.Gokhberg, V.M.Morozov and G.A.Otroshchenko.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 4, 791-4 (1956). In Russian.

Ionization chamber experiment. The known resonance at 265 keV was observed and interpreted as due to p-wave interaction of the incident neutron. W.O.Lock

539.172.4

4737. FURTHER MEASUREMENTS ON n,p REACTIONS AT 14 MeV. I. C.Badoni, L.Colli and U.Facchini.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1618-22 (Dec., 1956).

Using coincidences between a proportional counter and a scintillation counter, the energy spectra of protons were measured down to 3 MeV from Si, Ca and Zr under bombardment with 14.5 MeV neutrons. Improved measurements were also made on Mg and Zn. In all cases the spectra show a fall in proton numbers all the way from 3 MeV to the maximum energy obtainable from the (n,p) reactions; in some cases small bumps occur on the curves. See also Abstr. 723 (1957). J.H.Fremlin

539.172.4

4738. RELATIVE CROSS-SECTIONS FOR (n,p) REACTIONS IN NUCLEI WITH SEVERAL STABLE ISOTOPES. V.N.Levkovskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 360 (1956). In Russian.

The result of Paul and Clarke (Abstr. 2723/1953) that σ(n,p or n,α) decreases with increasing atomic number is extended to several more stable nuclides. J.W.Gardner

539.172.4 : 548.7

4739. RELATION BETWEEN THE SCATTERING OF NEUTRONS IN POLYCRYSTALS AND SPECIFIC HEAT. M.V.Kazarnovskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 4, 696-8 (1956). In Russian.

Formulae are given and in particular the variation with temperature of the total cross-section for coherent scattering of neutrons of energy equivalent to 17.2°K, incident on graphite, is calculated from specific heat data, using both exact and approximate formulae. Reasonable agreement with experimental data is obtained. W.O.Lock

539.172.4

4740. CROSS-SECTIONS FOR INELASTIC SCATTERING OF 2.5 MeV NEUTRONS BY NUCLEI. V.I.Strizhak.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 907-8 (1956). In Russian.

Neutron cross-sections were measured using a radioactive detector in which use is made of the threshold reaction P^{31} (n,p)Si^{31}. Results obtained for 26 different nuclei show that (1) for the majority of nuclei, the inelastic scattering cross-section of the 2.5 MeV neutrons increases smoothly with increasing mass number; (2) for a series of elements in which the number of nucleons is equal to a magic number, the inelastic scattering cross-section is perceptibly lower than cross-sections of neighbouring nuclei. Z.Krasuck

539.172.4 : 539.152

SCATTERING OF NEUTRONS BY U^{238}. See Abstr. 4622

539.172.4

4741. CALIBRATION OF A SPONTANEOUS FISSION NEUTRON SOURCE. R.Richmond.
Atomic Energy Res. Establ. (Harwell) Mem. RP/M 79, 3 pp. (1956).

A spontaneous fission neutron source, consisting of Pu containing Pu^{240}, is compared with the Oxford and Durham standard photoneutron sources and with the Harwell and Basel sources. A value for the strength of the Pu source of $1.99 \pm 0.04 \times 10^4$ neutrons/sec is obtained, but the final value will depend on the completion of the calibration of the Durham source. The measured value agrees to within a few percent with the calculated value, which suggests that

no significant contribution to the total neutron output is made by (α,n) neutrons arising from light-element impurities in the source. J.Thewlis

539.172.4

4742. FISSION CROSS SECTION OF U^{235} FOR FAST NEUTRONS. B.C.Diven.
Phys. Rev., Vol. 105, No. 4, 1350-3 (Feb. 15, 1957).

An absolute measurement of the fission cross-section of U^{235} for 1.27 MeV neutrons has been made. The neutron flux was measured with a recoil-proton proportional counter using a thin solid radiator of hydrogenous material. In addition, relative cross-sections have been measured between 0.403 and 1.620 MeV. These relative measurements also utilized a recoil-proton flux monitor. The cross-section has a constant value of 1.27 ± 0.044 barns in the neutron-energy interval between 1.0 and 1.5 MeV. A.

539.172.4

4743. CORRELATIONS BETWEEN THE NEUTRON MULTIPLICITIES AND SPONTANEOUS FISSION MODES OF CALIFORNIUM-252. D.A.Hicks, J.Isle, Jr, R.V.Pyle, G.Choppin and B.Harvey.
Phys. Rev., Vol. 105, No. 5, 1507-11 (March 1, 1957).

The numbers of prompt neutrons associated with specific fission modes of Cf^{252} have been measured. The average number of neutrons per fission depends largely upon the total kinetic energy of the fission fragments, decreasing by at least 0.06 neutron per fission for an increase of 1 MeV in the total kinetic energy. A less marked variation with the ratio of fragment masses is observed. A.

539.172.4

4744. NEUTRON EMISSION FROM FISSION MODES. R.B.Leachman and C.S.Kazek, Jr.
Phys. Rev., Vol. 105, No. 5, 1511-13 (March 1, 1957).

The number and energy of neutrons and the average energy of prompt gamma-rays emitted from various fission modes are estimated from the excitation-energy distributions of fragments from these modes. These excitation-energy distributions are derived from the mass equation of fission and the measured kinetic energies of the fragments. Simple considerations of neutron boil-off are used with these excitations. For the most probable mass ratios of fragments, the variation in the average number of neutrons $\bar{\nu}$ with the total kinetic energy E_K of the fragments is found to be $d\bar{\nu}/dE_K = -0.121$ MeV^{-1} for thermal-neutron fission of U^{235} and -0.116 MeV^{-1} for spontaneous fission of Cf^{252}. The spectra of neutron energies resulting from this analysis are found to have negligible change with E_K, but the neutrons from Cf^{252} fission are more energetic than those from thermal-neutron fission of U^{235}. The average energy E_γ of prompt gamma-rays from Cf^{252} fission is found to be 4.0 MeV, with a variation $dE_\gamma/dE_K = -0.0167$ for the most probable mass ratios of fragments. A.

539.172.4

4745. CALCULATION OF THE (INFINITE) MULTIPLICATION CONSTANT $[K_\infty]$ FOR HOMOGENEOUS MIXTURES OF NATURAL URANIUM AND A MODERATOR. A.G.Pinho Filho.
Rev. Fís. (Rio de Janeiro), Vol. 8, No. 1, 1-13 (1956). In Portuguese.

$K_\infty = epfn$, where; $e \geq 1$ is the fast fission factor, p is the probability of neutron capture by resonance, f is the fraction of neutrons absorbed in the atomic fuel, and n is the number of neutrons produced by the thermal neutrons absorbed in the fuel. These quantities are each expressed in terms of the ratio of the number of atoms of the moderator, Nc, to the number of atoms of the fuel, Nu. The variations of the quantities with Nc/Nu are graphed for: (a) Natural uranium in graphite, (b) a suspension of UO_2SO_4 in D_2O, and (c) a suspension of UO_2 in D_2O. p increases as f decreases, so that pf and therefore K_∞ pass through a maxima. The max. values of K_∞ are: 0.793 at Nc/Nu = 400 for case (a); 1.119 at Nc/Nu = 350 for (b); and 1.190 at Nc/Nu = 350 for (c). When $K_\infty = 1$ the chain reaction is critical. When $K_\infty > 1$ the reaction can be maintained in a reactor of finite bulk. When $K_\infty < 1$ the reaction extinguishes itself and it is not possible to have a homogeneous reactor. J.J.Phipps

539.172.4

4746. NUCLEAR ENERGY CONFERENCE, MILAN, 15-16 DECEMBER 1956.
Energia nucleare, Vol. 3, Supplement, 151 pp. (1956). In Italian.

Contains 14 papers presented at a conference which was organized by Italian professional scientific and technical societies in conjunction with state research institutes. The papers are general reviews of the technical aspects of nuclear energy production.

539.172.4

4747. POLONIUM PRODUCTION AND DECAY IN A BISMUTH REACTOR SYSTEM. W.H.L.Porter.
Atomic Energy Res. Establ. (Harwell) Mem. M/M119, LMFP/P3, 5 pp. (1956).

Polonium in a nuclear reactor with a bismuth fuel carrier is mainly of interest because of its serious ingestion hazard and of the formation of lead as a daughter product. With certain simplifying assumptions, calculations of the rate of production, the equilibrium weight and the fraction of final weight of polonium at any given time, the weight of lead produced, the rate of production of helium, and the activity and heat from the polonium, are carried out, and values are given for a typical reactor of 500 MW. A.O.Stanesby

539.172.4

4748. THE THEORY AND PRACTICE OF SHIELDING. C.C.Horton.
Atomic Energy Res. Establ. (Harwell) Lecture No. RS/L3, 16 pp. (1955).

An account of the absorption of neutrons and γ-radiation in large thicknesses of materials with special reference to the design of biological shields for nuclear reactors. The various physical processes involved in the attenuation of the incident radiation and the biological effectiveness of the transmitted radiation are discussed. Since capture predominates over scattering for γ-radiation, calculations based on an experimental absorption are used for calculating γ-attenuation. The effect of build-up of softer secondary radiation is included. In the case of the attenuation of a fast neutron flux, scattering predominates over capture and diffusion theory is used. The application of these methods of calculation to reactor shielding is considered in detail and illustrated with examples. R.D.Smith

539.172.4

4749. INSTABILITY IN SPERT-I. S.G.Forbes, F.Schroeder and W.E.Nyer.
Nucleonics, Vol. 15, No. 1, 41-3 (Jan., 1957).

Oscillations resulting in large power peaks of short effective period have been observed under certain operating conditions in the SPERT-I light-water moderated and reflected reactor. These instabilities appear when 1.5% of reactivity is held in voids in the reactor. The most violent oscillations were induced by adding reactivity when the core was at boiling point and had a large head of water. R.D.Smith

539.172.4

4750. COMPUTING 3-GROUP CONSTANTS FOR NEUTRON DIFFUSION. R.W.Deutsch.
Nucleonics, Vol. 15, No. 1, 47-51 (Jan., 1957).

Flux distribution and reactivity calibrations for homogeneous hydrogeneous reactors can be made accurately using three neutron energy groups. A method of determining suitable constants (diffusion coefficients, absorption, transport and slowing down cross-sections) from the available experimental data is given in detail. R.D.Smith

539.172.4 : 539.185

4751. ANTINEUTRINO FLUX FROM A REACTOR. C.O.Muehlhause and S.Oleksa.
Phys. Rev., Vol. 105, No. 4, 1332-4 (Feb. 15, 1957).

The antineutrino flux distribution from a thermal neutron reactor is determined from a measurement of the equilibrium beta-ray spectrum from thermal neutron fission of U^{235}. The antineutrino distribution is the folded in with the cross-sections for $\tilde{\nu}(p,n)\beta^+$ and $\tilde{\nu}(d,2n)\beta^+$ as a function of antineutrino energy. This determines the average antineutrino pile cross-sections, $\bar{\sigma}_p$ and $\bar{\sigma}_d$, respectively, for the above-cited reactions. The results are: $\bar{\sigma}_p = 6 \times 10^{-44}$ cm^2; $\bar{\sigma}_d = 2 \times 10^{-45}$ cm^2. A.

539.172.4 : 539.21

DAMAGING EFFECTS OF RADIATION ON SOLID REACTOR MATERIALS. See Abstr. 3743

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

4752. POLARIZATION METHOD FOR MEASURING SPEED OF PARTICLES HAVING INTRINSIC MAGNETIC MOMENT. S.G.Kornilov.

Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 512-13 (1956). In Russian.

When a beam of particles, each possessing intrinsic magnetic moment μ, passes through an alternating magnetic field (frequency ω) the degree of polarization induced depends on μ, ω and the particle velocity. From a knowledge of μ, ω and the polarization (measured by a "polarization spectrometer") the velocity is deduced.

J.W.Gardner

539.18

4753. QUANTUM NUMBERS OF THE LEE–YANG PARITY DOUBLET THEORY OF STRANGE PARTICLES. R.Gatto.
Z. Phys., Vol. 147, No. 3, 261-3 (1957).

The commutation rules between the relevant operators of the Lee–Yang parity doublets theory of strange particles are derived. It is shown that new quantum numbers can be constructed which provide new selection rules in physically important cases. A.

539.18

4754. K-MESON DECAY OF A SLOW SECONDARY PARTICLE. A.A.Varfolomeev, R.I.Gerasimova and L.A.Karpova.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 6, 959-62 (1956). In Russian.

A slow secondary particle of track length 26 μ is ejected from a cosmic-ray star in emulsion, comes to rest and gives rise to a particle identified as a 65 MeV K-meson and to 4.5 μ recoil track. Possible interpretations, none entirely satisfactory, are discussed.

W.O.Lock

539.18

4755. OBSERVATION OF A τ-MESON EVENT IN PHOTOGRAPHIC EMULSIONS. Y.Eisenberg and S.Rosendorff.
Bull. Res. Coun. Israel, Vol. 5A, No. 1, 70 (Nov., 1955).

A particle is observed to come to rest and emit three charged particles. One is arrested in the emulsion and is identified as a π^--meson. The others are identified as π-mesons. The Q-value is determined as 72.2 ± 3.5 MeV, the energy of the odd π-meson being 27.0 MeV.

D.J.A.Prowse

539.18

4756. A POSSIBLE EXAMPLE OF ANOMALOUS DECAY OF A HYPERFRAGMENT. A.A.Varfolomeev, R.I.Gerasimova and L.A.Karpova.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 5, 758-60 (1956). In Russian.

A hyperfragment decay found in emulsion exposed to cosmic rays is described and interpreted as either ${}_{\Lambda}H^4 \rightarrow He^3 + \pi^- + n + Q$ of $B_{\Lambda} = 5.1 \pm 1.8$ MeV or as the radiative decay of ${}_{\Lambda}H^3$ or ${}_{\Lambda}H^4$.

W.O.Lock

539.18

4757. WEAK DIRECT BOSON–LEPTON INTERACTION AND K-MESON DISINTEGRATION. B.d'Espagnat and J.Prentki.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1572-4 (Dec., 1956). In French.

It is attempted to eliminate certain boson-lepton interaction possibilities by deriving consequences in conflict with the abundance ratios $K_{\mu 2} : K_{\pi 2} : K_{\pi 3} : K_{\mu 3} : K_{e3} = 60 : 25 : 7.5 : 3 : 5$ reported by Goldhaber in the 1956 Rochester conference reports. The interactions considered are universal Fermi and Yukawa interactions and mixtures. It is assumed that muons and electrons interact with bosons in a similar manner and that muons, electrons and neutrinos have the same intrinsic parity. It is concluded that it is difficult to account for all K-meson disintegration types by Yukawa type interactions. If at production the number of θ's is much larger than the number of τ's the assumption of γ_5 coupling between τ's and leptons does not lead to contradiction with the observed abundances. But even then there are difficulties with θ^0.

H.Motz

539.18

4758. EVIDENCE FOR DIRECT EMISSION OF A PAIR OF γ-RAYS FROM THE POINT OF DECAY OF A K-MESON. M.S.Sinha and N.C.Das.
Phil. Mag. (Eighth Ser.), Vol. 1, 785-7 (Aug., 1956).

A cloud chamber picture is discussed of an event which the authors suggest can be interpreted as $K_{\mu 3} \rightarrow \mu + \gamma + \gamma$, or possibly as $K_{e3} \rightarrow e + \gamma + \gamma$. These schemes make the parent particle a fermion. There is a large uncertainty in the determination of its mass.

E.W.Kellermann

539.18

4759. INTERPRETATION OF K-MESON DECAYS. S.A.Bludman.
Phys. Rev., Vol. 102, No. 5, 1420-1 (June 1, 1956).

It is proposed that the near equality of the life-times of the τ and θ mesons is due to equal decay rates into $\mu + \nu$, which is assumed to be the dominant decay mode for each of them. This proposal could be distinguished from the Yang and Lee scheme, experimentally, by an analysis of the K_{μ} decay rate. P.T.Matthews

539.18

4760. CLOUD CHAMBER INVESTIGATION OF ANOMALOUS θ^0 PARTICLES. J.A.Kadyk, G.H.Trilling, R.B.Leighton and C.D.Anderson.
Phys. Rev., Vol. 105, No. 6, 1862-71 (March 15, 1957).

Eighteen anomalous θ^0, (θ^0anom), decay events observed in magnet cloud chambers have been analysed. Many of these decays are dynamically inconsistent with the $\tau^0 \rightarrow \pi^+ + \pi^- + \pi^0$ scheme, but most are consistent with the decay processes: $\theta^0\text{anom} \rightarrow \pi^+ + \pi^- + \gamma$, $\pi^{\pm} + \mu^{\mp} + \nu$, and $\pi^{\pm} + e^{\mp} + \nu$. However, at least one event is inconsistent with each decay scheme. From the locations of the decays in the cloud chamber, the lifetime is found to be significantly longer than that of the normal θ^0 particle, called here the $\theta^0_{\pi 2}$-particle. Other differences in the behaviour of the θ^0anom and $\theta^0_{\pi 2}$-particles were also observed in the (a) momentum distributions, (b) origin locations, (c) relative numbers of θ^0anom and $\theta^0_{\pi 2}$-particles travelling upward, and (d) the types of V-particles produced in association with the θ^0anom and $\theta^0_{\pi 2}$. It is concluded that not all the θ^0anom decays can result from alternate decay modes of the $\theta^0_{\pi 2}$. Moreover, many decays can be neither τ^0 decays nor alternate decays of the $\theta^0_{\pi 2}$. The characteristics of the θ^0_2 particle proposed by Gell-Mann and Pais are consistent with those of the θ^0anom-particle, with the possible exception of the observed types of associations. An estimate was made of the relative number of θ^0anom to $\theta^0_{\pi 2}$-particles observed to decay in the cloud chamber. If all θ^0anom decays are assumed to arise from decays of the θ^0_2-particle, then a lower limit for the θ^0_2 lifetime is found to be about 10^{-9} sec. A.

539.18

4761. ON SOME UNUSUAL V^0-PARTICLE DECAYS. A.B.Arlick.
Sci. and Culture, Vol. 22, No. 2, 106-9 (Aug., 1956).

Five undetermined neutral V-decays from among the Manchester and C.I.T. groups, cosmic-ray observations have been analysed by the method of Podolanski and Armenteros. These had been tentatively attributed by the observers to a hypothetical decay scheme $V^0 \rightarrow \pi^+ + \pi^- + 120/140$ MeV. Graphically it can be shown that if the events all belong to the same decay scheme, then they can be more accurately interpreted as an unusual kind of V-decay into two heavy mesons: $V^0 \rightarrow \tau^+ + \chi^- + 38$ MeV than by any other decay process. A.

539.18

4762. RELATIONS BETWEEN THE ANGULAR DISTRIBUTIONS OF PARTICLES AND THEIR DECAY PRODUCTS. Yu.D.Prokoshkin.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 732 (1956). In Russian.

For the case in which the angular distribution of the primary particle is a polynomial in $\cos\theta$ and the velocities of the secondary particles are assumed to be c, the velocity of light, expressions for the angular distributions of the secondary particles are given.

G.E.Brown

539.18

4763. ANGULAR CORRELATIONS IN K^0-DECAY PROCESSES. A.Pais and S.B.Treiman.
Phys. Rev., Vol. 105, No. 5, 1616-19 (March 1, 1957).

The reactions $K^0 \rightarrow \{e^{\pm} \text{ or } \mu^{\pm}\} + \nu + \pi^{\mp}$ afford a good opportunity to study fully the dynamics of decay processes involving leptons. It is shown that, under certain rather general assumptions customarily adopted in regard to weak lepton interactions, the distribution in angle between π and ν has a simple, uniquely specified form, independent of the properties of the K particle; namely, aside from a known, angle-dependent factor related to phase volume, the distribution is proportional to $A + B\cos\theta + C\cos^2\theta$, where A,B, and C may depend on the π momentum. For any given momentum, the relative magnitudes of A,B, and C when determined experimentally, can be expected to illuminate a second aspect of the problem; namely the detailed nature of the lepton coupling. The situation is especially transparent for the $e-\nu-\pi$ mode in the case that the K particle has zero spin. This is discussed in some detail. A.

539.18 : 539.166.2

4764. $\gamma-\gamma$ ANGULAR CORRELATION IN MESO-ATOMIC TRANSITIONS. V.A.Dzhrbashyan.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1090-2 (1956). In Russian.

The paper extends the work of Podgoretskii (Abstr. 2323/1956) in determining more precisely μ-meson spins by using data on angular correlation between γ-quanta radiated during successive meso-atomic transitions. A method is further suggested for checking nuclear spins for which the value I = 0 is doubtful, or obtained only from theoretical considerations not supported by experiment.

C.R.S.Manders

539.18

4765. SCATTERING OF POSITIVE AND NEGATIVE 300 MeV π-MESONS ON HYDROGEN. L.S.Dul'kova, I.B.Sokolova and M.G.Shafranova.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 5, 992-5 (1956). In Russian.

The scattering was studied by thick nuclear emulsions of type "R". A phase-shift analysis of the results was carried out by Ashkin's graphical method. Results fall off the lines of Orear for α_1 and α_3 and off the Chew–Low line for α_{33}; this may be because D-waves are important, but the experiment is not accurate enough to determine them. G.E.Brown

539.18

4766. MESON–NUCLEON SCATTERING IN THE TAMM–DANCOFF METHOD. K.Tanaka.
Phys. Rev., Vol. 105, No. 3, 1109-12 (Feb. 1, 1957).

The lowest-order old Tamm–Dancoff equation for pion–nucleon scattering without the closed loop contribution, is renormalized by using Cini's method. It is found that the spurious pole of the modified propagator including the nucleon self-energy effect does not appear for any momenta and for energies of the system where the lowest-order renormalization scheme is expected to be valid. For the $T = \frac{3}{2}$ $P_{3/2}$ state, a good fit with the experimental results up to 300 MeV is obtained with $G_1^2/4\pi = 11.6$. For the $T = \frac{3}{2}$ $S_{1/2}$ state, the value $G_1^2/4\pi = 12.5$ is required to give rough agreement with the experimental results up to 200 MeV. A.

539.18

4767. SCATTERING OF K^+ PARTICLES FROM PROTONS AND DEUTERONS. J.Bernstein.
Phys. Rev., Vol. 105, No. 6, 1853-8 (March 15, 1957).

The direct coupling between K-particles and π-mesons, proposed by Schwinger (Abstr. 2682/1957), has been used to calculate the scattering of K^+-particles from nucleons and deuterium. It is shown that this interaction gives a reasonable explanation of the observed forward peaking in the angular distribution of K^+-particles scattered from protons. The theory predicts an inhibition of elastic scattering from the deuteron. The energy spectrum for K^+-particles inelastically scattered from deuterium has been calculated assuming a simple model for the deuteron. There are no experiments presently available for deuterium. A.

539.18 : 539.172

SCATTERING OF FAST π^--MESONS ON NUCLEI. See Abstr. 4697

539.18

4768. NONRADIATIVE ABSORPTION OF POSITIVE PIONS BY DEUTERONS AT 118 MeV. C.E.Cohn.
Phys. Rev., Vol. 105, No. 5, 1582-7 (March 1, 1957).

The reaction $\pi^+ + d \rightarrow p + p$ was studied at a center-of-mass pion energy of 118 ± 2 MeV, using scintillation counters and a liquid deuterium target. The angular distribution was given by $d\sigma/d\Omega \propto A + \cos^2\theta$, with $A = 0.216 \pm 0.033$, while the total cross-section was 12.09 ± 0.93 mb. The total cross-section for the inverse pion production reaction was calculated from detailed balancing as 3.10 ± 0.24 mb. These results are compared with other work. A.

539.18

4769. ON THE ABSORPTION OF K-MESONS BY HELIUM NUCLEI. S.G.Matinyan.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 528-9 (1956). In Russian.

Recently Lee (Abstr. 9964/1955) has pointed out that several properties of these particles may be obtained by performing certain absorption experiments in deuterons, helium and carbon, and has suggested some relationships between the cross-sections of various processes. In this paper a further attempt is made on the same lines to obtain the full set of relationships between the cross-sections for all processes occurring in the interaction of K-mesons with helium nuclei. G.Martelli

539.18

4770. THE CAPTURE OF A Σ^--HYPERON WITHOUT ANY VISIBLE INTERACTION. K.Kristiansson and T.Johansson.
Ark. Fys., Vol. 11, Paper 18, 277-80 (1956).

In a nuclear emulsion an event has been found which can be explained as a Σ^--hyperon coming to rest, interacting with a nucleus and giving a 0-prong star. The hyperon has been identified by mass determinations according to four different methods. The probability of Σ^--hyperons giving 0-prong stars is discussed. A.

539.18

4771. INTERACTION OF 330 MeV NEGATIVE π-MESONS WITH HELIUM NUCLEI. M.S.Kozodaev, R.M.Sulyaev, A.I.Filippov and Yu.A.Shcherbakov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 701-3 (1956). In Russian.

Observations in a diffusion chamber gave 97 cases of this interaction. Cross-sections for the various elastic and inelastic processes are given. No small-angle elastic scattering is found, in disagreement with the simple optical model picture. G.E.Brown

539.18

4772. GENERATION OF π-MESONS BY COSMIC RAY PARTICLES OF HIGH ENERGY. Zh.S.Takibaev, P.A.Usik and M.G.Antonova.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 2, 341-4 (1956). In Russian.

Data are presented of a number of cases of shower formation resulting from interaction of cosmic-ray particles of high energy with atomic nuclei in photographic emulsions. The results are analysed from the point of view of the theory of multiple creation of mesons. Z.Krasucki

539.18

4773. ON MULTIPLE MESON PRODUCTION IN MESON–NUCLEON COLLISIONS AT VERY HIGH ENERGIES. E.Friedländer.
Acta phys. Hungar., Vol. 6, No. 2, 237-60 (1956).

The effects of any difference between the distributions of mass density within mesons and nucleons on the meson showers resulting from very high-energy meson–nucleon or nucleon–nucleon collisions are investigated. It is shown that by a reasonable choice of the mass-density distributions one can explain most of the rougher features of meson showers on strictly kinematical grounds, without reference to any special theory of the interaction. Such a theory must be used only to compute the multiplicity of the shower. An analysis of the very few accurately measured cases shows that the observed multiplicity can be explained by any one of the principal existing theories. It is concluded that only a great many experiments can decide in favour of one particular theory. A.

539.18

4774. PION PRODUCTION IN PION–NUCLEON SCATTERING. J.Franklin.
Phys. Rev., Vol. 105, No. 3, 1101-8 (Feb. 1, 1957).

The cross-section for the production of one additional pion in a pion–nucleon scattering is calculated using the Chew–Low theory of P-wave pion–nucleon scattering. The transition matrix element for the scattering of one meson into two mesons is defined in terms of exact eigenstates of the total Hamiltonian and an approximate expression is derived which expresses the one- to two-meson matrix element as a product of an elastic scattering matrix element and a meson-emission matrix element. Experimental elastic scattering phase-shifts are used in calculating the two-meson cross-section. The results of this calculation are used to estimate the effect of two-meson states on elastic scattering. The contribution to the effective range for elastic pion–nucleon scattering is small. Cross-sections are also obtained for all possible two-meson charge states from either a π^+ or a π^- meson incident on a proton. Comparison is made with experiment and the recent theoretical work of Barshay. A.

539.18

4775. PION PRODUCTION IN NUCLEON–NUCLEON COLLISIONS AT ENERGIES NEAR THRESHOLD. D.B.Lichtenberg.
Phys. Rev., Vol. 105, No. 3, 1084-8 (Feb. 1, 1957).

A calculation using the Chew theory indicates that nucleon–nucleon and pion–nucleon final-state interactions both play a role in contributing to the pion production cross-sections in nucleon–nucleon collisions at energies near threshold. In particular, it is found that the cross-section will be enhanced if (1) tensor forces lead to a D-wave nucleon–nucleon final-state interaction or if (2) the pion and one of the nucleons is in a state of isotopic spin 3/2 and angular momentum 3/2. Both of these effects are present if the isotopic spin of the initial two nucleons is unity and the isotopic spin of the final nucleons is zero. In the case of deuteron formation, it is found that the two effects are of the same order of magnitude, but depend differently on energy. A.

539.18

4776 ISOBARIC NUCLEON MODEL FOR PION PRODUCTION IN NUCLEON–NUCLEON COLLISIONS. S.J.Lindenbaum and R.M.Sternheimer.
Phys. Rev., Vol. 105, No. 6, 1874–99 (March 15, 1957).

A detailed quantitative model for pion production via excitation of one or both nucleons to an isobaric state with subsequent decay via pion emission is presented. The model is applied to the 0.8 to 3.0 BeV incident nucleon energy range and its predictions are compared to various experiments in this energy range. The isobaric state with isotopic spin and angular momentum = $\frac{3}{2}$ observed in the

pion–nucleon scattering was assumed to be predominantly responsible for pion production in this energy range. The relative probability for isobar formation, and subsequent decay with a variable total energy or mass in the isobar rest system, was phenomenologically related to the π^+–p interaction cross-section. The energy or momentum spectra of pions, and nucleons, the variation of the ratio of double to single production, the angular correlation, and the Q-value distribution for pion–nucleon pairs have been calculated at various energies from 0.8 to 3.0 BeV and generally agree with the experimental results. A.

539.18

4777. THE PRODUCTION OF π-MESONS IN PROTON–PROTON COLLISIONS AT 925 MeV. I.S.Hughes, P.V.March, H.Muirhead and W.O.Lock.
Phil. Mag. (Eighth Ser.), Vol. 2, 215-30 (Feb., 1957).

A study has been made of the production of π-mesons in the collisions of protons having an energy of 925 MeV, with the hydrogen present in nuclear emulsions. The results yield the following cross-sections:

$p + p \rightarrow \pi^+ + n + p$	27 ± 3 millibarns,
$\pi^+ + D$	0.6 ± 0.4 millibarns
$\pi^0 + p + p$	6 ± 2 millibarns
$\pi^+ + \pi^- + p + p$	≤ 0.2 millibarns

Angular and momentum distributions have been obtained for particles emitted in the first process. The results may be interpreted in terms of the production of mesons by the decay of an excited nucleon. A.

539.18

4778. PION PRODUCTION IN ELECTRON-PROTON COLLISIONS. R.H.Dalitz and D.R.Yennie.
Phys. Rev., Vol. 105, No. 5, 1598-615 (March 1, 1957).

The close relationship between photopion and electropion production from protons allows an unambiguous first estimate (the standard value) for the ratio of these cross-sections, based on assumptions very close to those of the Weizsäcker–Williams method. Deviations of the ratio from this estimate arise from pion production by the longitudinal components of the field of the scattered electron and from the variation of the off-diagonal transverse excitations from their diagonal photoproduction values. The dependence of these deviations on the physical processes contributing to the electromagnetic excitation of pions is discussed in terms of matrix elements specified in the pion–nucleon centre-of-mass system, both for phenomenological contributions and for specific meson theories. The experimental values reported are interpreted as an indication of the smallness of longitudinal production, in qualitative accord with the fixed source theory. These features may also be investigated by study of the energy spectrum of inelastically scattered electrons and of the azimuthal variation of pion production relative to the scattering plane, which are also discussed. A.

539.18

4779. PAIR PRODUCTION OF S-WAVE PI MESONS. A.M.Bincer.
Phys. Rev., Vol. 105, No. 4, 1399-407 (Feb. 15, 1957).

A theory for pair production of s-wave π-mesons is constructed along the lines of the Chew–Low–Wick formalism. A bilinear s-wave interaction of the form $(\lambda_0/\mu)\bar{\Phi}\cdot\bar{\Phi} + (\lambda/\mu^2)\bar{\tau}\cdot\bar{\Phi} \times \bar{\pi}$ as used by Drell, Friedman, and Zachariasen is added to the p-wave interaction $(4\pi)^{1/2}(f/\mu)\bar{\sigma}\cdot\bar{\Delta}\bar{\tau}\cdot\bar{\phi}$ as used by Chew and Low. It is shown that if the s-wave interaction is limited to the λ_0 term (scalar pair theory) the cross-section for pair production of s waves vanishes. By using both the λ_0 and λ terms, the cross-section for inelastic scattering of a p-wave meson into two s-wave mesons, near threshold (total energy of the produced mesons $\leq$ 350 MeV), per unit energy of one of the produced mesons is determined to be of the order of millimicrobarns/MeV; for photoproduction the corresponding number is $\sim$ 1000 times smaller. A comparison is made with the work of Cutkosky and Zachariasen and it is concluded that if there is no meson–meson interaction s-wave pair production may be neglected excepted possibly as the very threshold. A.

539.18

4780. PHOTOPRODUCTION OF PION PAIRS IN HYDROGEN. R.M.Friedman and K.M.Crowe.
Phys. Rev., Vol. 105, No. 4, 1369-77 (Feb. 15, 1957).

The photoproduction of pion pairs ($\pi^- + \pi^+$) has been measured by observing a π^- signal from liquid hydrogen bombarded with bremsstrahlung of energies up to 600 MeV. The excitation function and π^- energy spectrum measured at 60° in the laboratory system agree qualitatively with the calculations of Cutkowsky and Zachariasen. The major part of the process corresponds to the emission of the π^+ in the resonant P state and the π^- in an S state. The net increase in the π^+ yield due to $(\pi^- + \pi^+)$ and $(\pi^0 + \pi^+)$ pairs is also observed. A.

539.18

4781. PHOTOPRODUCTION OF PAIRS OF π-MESONS IN HYDROGEN AND DEUTERIUM NEAR THE THRESHOLD, AND ISOTOPIC INVARIANCE. N.V.Dushin.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 355-6 (1956). In Russian.

The cross-section for this process near the threshold is calculated by considering the interaction of the electromagnetic field with the meson–nucleon system to a first approximation in perturbation theory, and by assuming isotopic invariance. G.Martelli

539.18

4782. THE GENERATION OF μ-MESON PAIRS BY γ-QUANTA ON ATOMIC NUCLEI. L.M.Afrikyan.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1094-5 (1956). In Russian.

It is noted that during the interaction of γ-quanta of high energy ($h\nu \gg 200$ MeV) with nuclei, besides the "normal" effect of free μ-meson pair formation, there can also occur an effect corresponding to the direct birth of a μ^--meson which forms pairs on the K-shell of a meso-atom. The theoretical and experimental difficulties of the problem are discussed. C.R.S.Manders

539.18 : 539.172.3

4783. DISPERSION RELATIONS FOR THE PHOTOPRODUCTION OF PIONS. A.A.Logunov and B.M.Stepanov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 3, 368-70 (1956). In Russian.

The formulation of the dispersion relations is greatly facilitated by the introduction of a set of anti-Hermitian matrix operators to express the interaction between the pion and photon fields. J.W.Gardner

539.18 : 539.172.3

4784. PHOTOPRODUCTION OF SLOW π^- MESONS IN COMPLEX NUCLEI. E.G.Gorzhevskaya and N.M.Panova.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1205-8 (1956). In Russian.

Photographic emulsions were exposed to gamma-rays of maximum energy 250 MeV. The cross-section for the production of π^--mesons of energy less than 4 MeV was found to be $2.2 \pm 0.33 \times 10^{-29}$ cm^2 for light nuclei and $8.8 \pm 0.9 \times 10^{-29}$ cm^2 for heavy nuclei. The angular distribution of the associated fast protons ($E > 20$ MeV) shows a strong forward peaking. The data are consistent with single nucleon excitation by the incident gamma-ray in the majority of the events. W.O.Lock

539.18 : 539.172.3

4785. DEPENDENCE OF PHOTOPRODUCTION CROSS-SECTIONS OF π^0-MESONS ON MASS NUMBERS OF NUCLEI. B.B.Govorkov, V.I.Gol'danskiĭ, O.A.Karpukhin, A.V.Kutsenko and V.V.Pavlovskaya.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 1, 37-40 (1957). In Russian.

For light nuclei, at least up to oxygen, the photoproduction cross-section of π^0-mesons increases approximately as $\sigma \sim A$, and it is only for higher mass numbers that the dependence $\sigma \sim A^{2/3}$ is established. Z.Krasucki

539.18

4786. PHOTOPRODUCTION OF CHARGED MESONS FROM DEUTERONS. S.Penner.
Phys. Rev., Vol. 105, No. 3, 1113-16 (Feb. 1, 1957).

The photoproduction cross-sections of charged mesons from deuterons is calculated in the impulse approximation. Expressions for the angular distribution and total cross-section are obtained in terms of free-nucleon cross-sections and the nuclear potential. The results are in good agreement with the experimental measurements of π^+ production near threshold. A.

539.18 : 539.172.3

4787. Z DEPENDENCE OF POSITIVE PHOTOPION PRODUCTION. W.S.C.Williams, K.M. Crowe and R.M.Friedman.
Phys. Rev., Vol. 105, No. 6, 1840-5 (March 15, 1957).

The Z dependence of positive photopion production has been measured with 550 MeV bremsstrahlung. The data are compared with the optical model using the real and imaginary potentials given by Frank, Gammel, and Watson. If variations in the production cross-section due to the real potential, including the Coulomb potential, are taken into account, the agreement for pion energies in the range 33 to 152 MeV is surprisingly good considering both the approximations in the model and the experimental errors. The observed absorption mean free path varies from $\sim 9 \times 10^{-13}$ cm for 33 MeV pions to $\sim 1 \times 10^{-13}$ cm at the highest energies. A.

539.181 : 537.533.74

RADIATIVE COLLISIONS BETWEEN ELECTRONIC AND MOLECULAR BEAMS. See Abstr. 4451

539.185

4788. INCOHERENT NEUTRON SCATTERING BY POLYCRYSTALS. G.Placzek.
Phys. Rev., Vol. 105, No. 4, 1240-1 (Feb. 15, 1957).

General expressions are given for the first terms in the expansion in powers of the neutron to nuclear mass ratio of the total cross-section for incoherent scattering of neutrons by polycrystals. Special limiting cases of these expressions have been published earlier (Abstr. 6014/1954). A.

539.185

4789. NEUTRON YIELDS FROM THICK TARGETS BOMBARDED BY 24-MeV DEUTERONS AND 12-MeV PROTONS. W.E.Crandall, G.P.Millburn and L.Schecter.
J. appl. Phys., Vol. 28, No. 2, 273-6 (Feb., 1957).

The gross yields of neutrons produced by 24 MeV deuterons bombarding Be, Cu, Ta and U and by 12 MeV protons bombarding Be, Cu and Ta were measured by detecting the neutrons in a solution of $MnSO_4$ that surrounded the targets. The yields were (in neutrons per μcoulomb): 24 MeV deuterons: Be, 1.85×10^{11}; Cu, 0.55×10^{11}; Ta, 0.52×10^{11}; U, 0.73×10^{11}; 12 MeV protons: Be, 4.1×10^{10}; Cu, 0.61×10^{10}; Ta, 0.15×10^{10}. A.

539.185

4790. ANTINEUTRONS PRODUCED FROM ANTIPROTONS IN CHARGE-EXCHANGE COLLISIONS. B.Cork, G.R.Lambertson, O.Piccioni and W.A.Wenzel.
Phys. Rev., Vol. 104, No. 4, 1193-7 (Nov. 15, 1956).

An antiproton beam obtained from the Bevatron was passed into a large toluene—terphenyl scintillation counter backed by thin anticoincidence counters. Events occurred in which the anticoincidence counters were not tripped, while the pulse in the liquid scintillator was much smaller than would be expected if the antiproton had annihilated inside it. On these occasions a large glass Cherenkov counter (or sometimes a large scintillation counter) placed behind the anticoincidence counters gave very large pulses. These were interpreted as being due to the annihilation of antineutrons produced by a charge-exchange collision in the toluene—terphenyl counter. The charge-exchange cross-section of carbon for antiprotons of momentum 1.4 BeV/c is about 8 millibarns. J.M.Cassels

539.185

4791. DETECTION OF THE FREE NEUTRINO: A CONFIRMATION. C.L.Cowan, Jr, F.Reines, F.B.Harrison, H.W.Kruse and A.D.McGuire.
Science, Vol. 124, 103-4 (July 20, 1956).

The reaction $\nu_- + p^+ \rightarrow \beta^+ + n^0$ of free neutrinos with protons was investigated near a large nuclear reactor, and the results of a number of checks confirm the detection of the free neutrino; the cross-section of the reaction was within 5% of the predicted value of 6.3×10^{-44} cm^2 (itself uncertain by ±25%). A.O.Stanesby

539.185 : 532.7

NEUTRON SCATTERING CROSS-SECTIONS OF A^{38} AND A^{40}. See Abstr. 4015

539.185 : 537.534.74

NEUTRON—PROTON SCATTERING. See Abstr. 4463

539.185 : 539.132

MOLECULAR SPECTROSCOPY BY NEUTRON BOMBARDMENT. See Abstr. 4580

STRUCTURE OF SOLIDS 539.2

539.211

4792. STUDY OF ATOMIC STRUCTURE OF METAL SURFACES IN THE FIELD ION MICROSCOPE. E.W.Müller.
J. appl. Phys., Vol. 28, No. 1, 1-6 (Jan., 1957).

Details of the image formation in the low-temperature field-ion microscope are discussed. The hopping height of the rebounding gas atom, which depends on the atom's polarizability, the tip temperature, tip radius, and field, is significant for the resolution. Photographs of tungsten and rhenium surfaces with the atomic lattice resolved and in different states of disorder are presented. A colour printing technique, which permits finding quickly a few displaced atoms among the many thousand that are visible, is described. A.

539.213.2 : 535.81

A STUDY OF GLASSES CONSISTING OF THE ELEMENTS OF LOW ATOMIC WEIGHT. See Abstr. 4262

539.213.22

4793. RELAXATION THEORY OF VITRIFICATION. I. SOLUTION AND INVESTIGATION OF THE FUNDAMENTAL EQUATION. M.V.Vol'kenshteĭn and O.B.Ptitsyn.
Zh. tekh. Fiz., Vol. 26, No. 10, 2204-22 (1956). In Russian.

A kinetic theory of vitrification is advanced, based on the description of structural relaxation in the system by a first-order chemical reaction equation. A solution of this equation is obtained and investigated. An expression for the temperature of vitrification softening, T_y, as a function of the rate of cooling or heating and of the molecular parameters of the system, is given. It is shown that in vitrification liquid freezes in a structure corresponding to equilibrium at a temperature somewhat above T_y, and that in cooling and subsequent heating there should be a structural hysteresis, even when the rates of these processes are identical. R.C.Murray

539.215.2.08 : 538.222

4794. MAGNETIC GRANULOMETRY AND SUPER-PARAMAGNETISM. C.P.Bean and I.S.Jacobs.
J. appl. Phys., Vol. 27, No. 12, 1448-52 (Dec., 1956).

The magnetic technique of particle size measurement based on the work of Elmore consists of a comparison of a modified Langevin curve with the observed magnetization curve for an appropriate system of ferromagnetic particles. The average magnetic moment per particle is obtained from this analysis, and the average particle size is thus determined. The prediction by Néel of thermal relaxation in single-domain ferromagnetic particles broadens the range of applicability of the granulometry method, with special emphasis on the size range from 20 A to about 100 A. A possible objection to the method, arising from evidence for an abnormal temperature dependence of the saturation magnetization of very small magnetic particles, is re-examined experimentally and found to be invalid. Several examples are presented that demonstrate the predicted thermal relaxation and that point to a wide utilization of the granulometry technique. A.

539.217

4795. MEASUREMENT OF DIFFUSION COEFFICIENTS BY A METHOD OF CONTINUOUS MEASUREMENTS. V.P.Vasil'ev.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 1, 61-3 (1956). In Russian.

The method relies on the continuous observation of the activity of a specimen (mounted in vacuum) into which a radioactive isotope is diffusing. The diffusion coefficient may be obtained from a graph of the ratio of the activities with and without diffusion heating v. $(\text{time})^{1/2}$. Results are quoted for the self-diffusion of silver, ranging from 1.28×10^{-11} cm^2 sec^{-1} at 930°K to 1.01×10^{-10} at 1010°K. Full experimental details are given. The accuracy quoted is 35 to 38% but suggestions for improving on this figure are made. J.B.Arthur

539.217 : 539.219

4796. X-RAY DETERMINATION OF THE COEFFICIENTS OF HETERODIFFUSION IN ALLOYS FORMING SUBSTITUTION SOLID SOLUTIONS. B.Ya.Pines and É.F.Chaĭkovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1234-7 (1956). In Russian.

By a technique which is described, it has been found that in the copper—nickel system the diffusion coefficient at 800°C is constant at 10×10^{-11} cm^2/sec between 32 and 50 atomic % of copper, and then increases to 19.2×10^{-11} cm^2/sec at 86 atomic % of copper. R.C.Murray

539.217 : 548.7

4797. EFFECT OF STRUCTURAL DEFECTS IN GERMANIUM ON THE DIFFUSION AND ACCEPTOR BEHAVIOR OF COPPER. C.S.Fuller and J.A.Ditzenberger.
J. appl. Phys., Vol. 28, No. 1, 40-8 (Jan., 1957).

The effect of dislocations in Ge upon the diffusion of Cu has been studied using Ge crystals having different etch-pit counts as well as on Ge specimens bent on a (112) axis. The percentage of the total Cu introduced in a given time which attains the acceptor state was measured by comparing conductivity to radioactivity determinations employing Cu^{64}. In addition, the detailed diffusion processes have been studied as a function of time and etch-pit density by means of autoradiographs taken both parallel and perpendicular to the direction of diffusion and also by delineation of p—n boundaries. The two most important findings are: (1) the slow attainment of acceptor equilibrium especially in Ge having low concentrations of dislocations and (2) the identification of dislocations as the initial loci of acceptor copper in Ge. The results call for a revision of our ideas on the mechanism of diffusion of Cu. The view is advanced that Cu atoms enter Ge interstitially at a high rate ($> 10^{-4}$ cm^2/sec), but that their

flow and ultimate concentration is limited by the effective rate of generation and equilibrium concentration of vacancies chiefly at dislocations. A.

539.217

4798. DIFFUSION IN ORDERED AND DISORDERED COPPER–ZINC. A.B.Kuper, D.Lazarus, J.R.Manning and C.T.Tomizuka.
Phys. Rev., Vol. 104, No. 6, 1536-41 (Dec. 15, 1956).

The diffusivities of Cu^{64}, Zn^{65} and Sb^{124} in single crystals of 47-48 atomic % zinc copper–zinc (beta-brass) have been measured over the temperature range 265-817°C, by using sectioning techniques. The diffusion coefficients show a striking dependence on the degree of long-range order at temperatures below the critical temperature (468°C). A slight dependence of the diffusion coefficient on short-range order is noted above the critical temperature. The diffusion coefficients obey an Arrhenius equation only in the fully disordered phase, with temperature dependences given by $D_{Cu} = 0.011 \exp(-22\,000/RT)$ cm²/sec; $D_{Zn} = 0.0035 \exp(-18\,800/RT)$ cm²/sec; $D_{Sb} = 0.08 \exp(-23\,500/RT)$ cm²/sec. The variation of the diffusion coefficients with temperature in the ordered phase is considered in terms of a simple elastic model. Excellent agreement is obtained by using the measured elastic constants and assuming that the energy for motion of the imperfection is simply related to the smallest (110) shear modulus. In the disordered phase Sb diffuses faster than Zn or Cu, while in the ordered phase Sb diffuses at the same rate as Zn, which is faster than Cu. This result is shown to be inconsistent with an interchange, interstitial, or nearest-neighbour vacancy mechanism for diffusion. The result is consistent with an interstitialcy mechanism. A.

539.217

4799. EVIDENCE FOR VACANCY MECHANISM IN INTER-METALLIC DIFFUSION. L.Slifkin and C.T.Tomizuka.
Phys. Rev., Vol. 104, No. 6, 1803-4 (Dec. 15, 1956).

A vacancy mechanism for diffusion is assumed and the ratio of the tracer diffusion coefficients of Zn and Cu in partially ordered β-brass is then discussed as a function of the long-range order parameter. Agreement with experimental data (preceding abstract) is good. [The theoretical discussion appears to neglect the requirement of thermodynamic equilibrium.] A.B.Lidiard

539.217

4800. DIFFUSION OF LEAD IN LEAD TELLURIDE.
B.I.Boltaks and Yu.N.Mokhov.
Zh. tekh. Fiz., Vol. 26, No. 11, 2448-50 (1956). In Russian.

Investigations were made using single crystals of PbTe, prepared from purified tellurium and pure lead. Coefficients of diffusion, D, of lead in lead telluride were measured by the method of electron–hole transitions. Dependence of the coefficient D on temperature, T, is given by: $D = 2.9.10^{-5} \exp(-0.6/kT)$ cm²/sec.

Z.Krasucki

539.217.5

4801. PERMEATION OF GASES THROUGH SOLIDS. F.J.Norton.
J. appl. Phys., Vol. 28, No. 1, 34-9 (Jan., 1957).

The permeation process consists of the steps: adsorption, solution, diffusion, and desorption. These are discussed for glasses, polymers, and metals. There are two generalizations: (1) All gases go through all polymers, (2) No rare gas permeates any metal. Criteria are given for measurements of the permeation process. In glasses the permeation rate depends on atomic size and glass composition. Some special processes which may simulate permeation in vacuum devices are discussed: oxide dissociation, electrolysis in ceramic materials, nuclear reactions, and ionic impact. A.

539.217.5

4802. GAS PERMEABILITY OF POLYORGANOSILOXANE RESINS. S.A.Reĭtlinger, A.A.Maslennikova and I.S.Yarkho.
Zh. tekh. Fiz., Vol. 26, No. 11, 2553-8 (1956). In Russian.

These resins have high gas permeability because of the high diffusion rates of gases in them. The energies of activation for diffusion and gas permeability in them are a great deal lower than in carbon-chain elastomers. The reasons advanced are the high flexibility of the low intermolecular interactions between the chain molecules of the siloxane resins. R.C.Murray

539.219 : 539.234 : 548.74

4803. PREPARATION AND ELECTRON DIFFRACTION STUDY OF THIN FILMS OF METALLIC ALLOYS. P.Michel.
Ann. Phys. (Paris), Sér. 13, Vol. 1, 719-44 (July-Aug., 1956). In French.

Thin films of the alloy systems Ag–Mg, Ag–Sn, Ag–Zn, Cu–Au and Cu–Al were prepared by simultaneous evaporation of the two elements concerned, and examined by electron diffraction. The alloys formed immediately those phases with simple (f.c.c., b.c.c., or h.c.p.) structures; in place of a known complex phase, mixtures of two adjacent simple phases occurred. However, after ageing for up to several months at room temperature, the γ phases of Ag–Zn and Cu–Al, and the ordered β-phase of Cu–Al were identified. When the two elements were evaporated successively, only the diffraction patterns of the separate elements were observed for Ag–Mg, Cu–Al and Cu–Au, but Ag–Sn and Ag–Zn gave alloys. This difference is well explained by the different rates of interdiffusion of the metals calculated from published data obtained at high temperatures in massive samples. R.S.Pease

539.219

4804. ON GALLIUM ARSENOSELENIDES. N.A.Goryunova and V.S.Grigor'eva.
Zh. tekh. Fiz., Vol. 26, No. 10, 2157-61 (1956). In Russian.

Nine alloys having the general composition $mGaS,(1-m)Ga_2Se_3$ were prepared. The triangular diagram of the system, and the Debye X-ray photograph of each alloy are reproduced. Microstructure, thermal behaviour, electrical conductivity and density were also investigated and are discussed in relation to the physico-chemical behaviour of the system. R.F.S.Hearmon

539.219 : 536.654

CHANGES IN THE PARTIAL VALUES OF THERMODYNAMIC QUANTITIES FOR IRON IN SOLID IRON–CHROMIUM ALLOYS.
See Abstr. 4291

539.231

4805. CONTROLLED SPUTTERING OF SINGLE CRYSTALS. G.K.Wehner.
Appl. sci. Res. B, Vol. 5, No. 1-4, 334-6 (1955).

Material sputtered from metal single-crystal balls and deposited on a glass collector plate shows patterns similar to electron field emission patterns. It is reported that experiments on Ag, Cu, W, Mo, Fe and Ge show that the sputtered atoms are preferentially ejected in the direction of close packing and the changes in the patterns for different energies of the bombarding ions reveal interesting details of the sputtering process. From the information collected so far it is stated that it can be concluded that sputtering at low ion energy is a momentum transfer process. S.Weintroub

539.231

4806. SUPPLEMENTARY SPUTTERING CALCULATIONS. D.E.Harrison, Jr.
Phys. Rev., Vol. 105, No. 4, 1202-3 (Feb. 15, 1957).

The theoretical curves of a preceding paper (Abstr. 6211/1956) have been recalculated using the sputtering threshold values predicted by Wehner. The parameters of the new calculation follow a more regular pattern, and the numerical values are more realistic. Although the new curves differ from those previously reported, the variations are hardly significant. A.

539.234 : 548.55

4807. AN INVESTIGATION OF SINGLE CRYSTAL LAYERS OF GERMANIUM OBTAINED BY EVAPORATION IN VACUUM. G.A.Kurov, S.A.Semiletov and Z.G.Pinsker.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 6, 970-1 (1956). In Russian.

20-30 μ layers were prepared by evaporating n- and p-type Ge under ~ 10^{-5} mm Hg pressure onto etched or cleaved Ge held at 450-900°C. From electron diffraction data true single crystal layers were obtained only when substrates were held above 750-800°C. Lower temperatures gave mosaic structures. All layers were p-type and of low resistivity and carrier mobility. Annealing at 500°C effected little improvement. The poor electrical properties were ascribed to structural defects since a layer evaporated onto alumina from n-type material reverted to high resistivity n-type after being melted and then annealed. C.H.L.Goodman

539.27

4808. NEW METHOD FOR THE PREPARATION OF THIN METALLIC FILMS IN THE ELECTRON MICROSCOPE. N.Takahashi and K.Kazato.
C.R. Acad. Sci. (Paris), Vol. 243, No. 19, 1408-11 (Nov. 5, 1956). In French.

In this method a drop of the metal is melted in a fine wire loop and thrown against a polished metal plate. The resulting specimen retains the constitution of the bulk metal or alloy, and is composed of small single crystals supported on an oxide film. Metals with melting points below 900°C can be prepared in air, while those having higher melting points need to be prepared in an inert atmosphere. Electron micrographs and diffraction patterns of a number of alloy specimens prepared in this way are shown.

A.E.I. Research Laboratory

ELASTICITY. STRENGTH. RHEOLOGY

539.3/.8

539.31

4809. ANISOTROPIC RELAXATION PEAK IN THE INTERNAL FRICTION OF CRYSTALLINE QUARTZ. J.H.Wasilik.
Phys. Rev., Vol. 105, No. 4, 1174-80 (Feb. 15, 1957).

An anisotropic relaxation peak has been observed in the internal friction of crystalline quartz. The height of the loss peak increases by a factor of 2.1 between a sample stressed in the Y direction and one stressed in a direction -18.5° from the Y axis. The shape of the observed relaxation peaks can be fitted by a theory of Zener for a relaxation of a preferred distribution of impurities induced by stress, using an activation energy of 24 kcal/mole and a relaxation time of 0.6×10^{-14} sec. The possibility is discussed that this relaxation peak and one observed by Cook and Breckenridge are due to lithium. A.

539.32

4810. THE ELASTIC CONSTANTS OF ANISOTROPIC MATERIALS. II. R.F.S.Hearmon.
Advances in Phys., Vol. 5, 323-82 (July, 1956).

Continuation of Abstr. 1654 (1947), 4662 (1952). A review of theoretical and experimental work published between 1945 and 1955 with about 400 references. R.F.S.Hearmon

539.32 : 539.431

4811. INTERNAL FRICTION AND FATIGUE IN METALS AT LARGE STRAIN AMPLITUDES. W.P.Mason.
J. Acoust. Soc, Amer., Vol. 28, No. 6, 1207-18 (Nov., 1956).

A barium titanate transducer coupled to an exponential horn can produce large strains in metals. By using a final horn with a necked down section, it is possible to concentrate the strains in a small specimen. Measurements of the impressed voltage and a voltage from a pick-up electrode on the titanate make it possible to calibrate the device so that the internal friction, change in elastic constant, and the strain in the sample are all determined. The measured internal friction can be divided into three strain regions. From 10^{-6} to 10^{-5} the internal friction is approximately independent of the strain. For strains from 10^{-5} to from 2×10^{-4} to 2×10^{-3}, depending on the material, the internal friction increases with strain in a reversible manner. Above this range the internal friction increases very rapidly and for strains twice as large as those for the initial rise, the metal fatigues in a very short time. It appears that the anelastic range is caused by the reversible production of unstable Frank—Read loops. The shape of the internal friction curve allows one to evaluate the dislocation distribution with results in accord with etch-pit methods. The final phase appears to be due to irreversible production of Frank—Read loops caused by dislocations cutting through other dislocations. This process produces jogs in the dislocations and vacancies in the metal. These vacancies accumulate to produce fatigue cracks in accord with a theory of Mott's. Temperature and time effects result from the lowering of the activation energy by the applied stress. At liquid nitrogen temperature, the fatigue stress increases until the activation energy for diffusion is nearly zero. A.

539.32.08 : 532.123.08 : 534.213

ACOUSTICAL MEASUREMENT OF ELASTIC PROPERTIES OF SOLIDS. See Abstr. 4053

539.371

4812. ELECTRON MICROSCOPY OF ALUMINUM CRYSTALS DEFORMED AT VARIOUS TEMPERATURES. T.S.Noggle and J.S.Koehler.
J. appl. Phys., Vol. 28, No. 1, 53-62 (Jan., 1957).

99.994% pure aluminium single crystals were deformed in tension at 4.2°K, 78°K and 295°K. The deformation at 4.2°K produced fine slip, observed by electron microscopy, and gave rise to a linear stress—strain curve. At 78°K at low strain one again observed fine slip and a linear stress—strain curve; at large strains (resolved shear strain above about 0.25) a weak slip band structure developed progressively and the slope of the stress—strain curve decreased. The stress—strain curves were orientation dependent at all temperatures. A.

539.374

4813. PLASTIC DEFLECTION OF ICE BEAMS.
K.F.Volstkovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 3, 383-6 (1956). In Russian.

The deflection under approximately 4-point loading was measured as a function of time and temperature. The relation between deflection velocity and bending load was similar to that found by Glen (Abstr. 4137/1955) for polycrystalline ice in compression. An empirical formula is given for calculating the total deflection after any lapse of time. See also Abstr. 1689/1957. R.F.S.Hearmon

539.374

4814. VISCOELASTIC PROPERTIES OF POLYMERIC SUBSTANCES. K.Shibata.
Sci. Rep. Yokohama Nat. Univ. I, No. 4, 19-46 (Oct., 1955).

Creep in torsion and bending of polymethyl methacrylate is found to be linear when plotted against time (range 10^4 min) on a logarithmic scale. The results are compared with the theories of Tobolsky and Eyring (1943) and Gross (1947). Dynamic measurements of Young's modulus at 500 and 1000 c/s in the temperature range 20-120° C are reported and Gross's theory is used to correlate the transient and steady state results. J.E.Caffyn

539.374 : 538.245

THE INFLUENCE OF PLASTIC DEFORMATION ON THE BARKHAUSEN EFFECT. See Abstr. 4551

539.377

4815. INVESTIGATION OF THE ANNEALING OF DEFORMED NICKEL POWDER BY X-RAY AND STORED ENERGY MEASUREMENTS. D.Michell and F.D.Haig.
Phil. Mag. (Eighth Ser.), Vol. 2, 15-32 (Jan., 1957).

The stored energy was measured by a calorimetric method. The measured value of 3.6 cal/g and the manner of its release suggests that a wide range of deformations is present, both the maximum and average deformations being considerably greater than those present in heavily deformed solid specimens of nickel. The diffraction patterns, measured with a Geiger counter spectrometer, show that during annealing there is no change in the background intensity. The integrated intensities of the high-angle lines remain constant and small changes in the low-angle lines are attributed to changes in extinction. Only small changes occur in the tails of the lines at temperatures of annealing up to 400°C. No evidence has been found for stacking faults or changes in lattice parameter. The diffraction profiles are analysed by a number of methods, the broadening in each case being attributed partly to strain and partly to small particle size. The results indicate two stages in the relief of strain. The first occurs mainly in the less severely deformed regions without increase in the "apparent particle size" and is attributed to recovery. In the second, all the remaining strain is relieved by recrystallization with an increase in the "apparent particle size". For the deformed powder the "apparent particle size" is in the range 350-2300 A and the energies derived from the analyses range from 0.02-1.5 cal/g. The discrepancy between the calculated values of energy and the value obtained experimentally is discussed in terms of the distribution of strain within the crystal. A.

539.4.016

4816. THE COLD WORK INTRODUCED DURING THE FATIGUE OF COPPER. R.D.McCammon and H.M.Rosenberg.
Phil. Mag. (Eighth Ser.), Vol. 1, 964-6 (Oct., 1956).

Specimens of polycrystalline high-conductivity Cu were annealed at 600°C for 3 hours in argon and furnace-cooled, after which they were deformed in fatigue or tension by a Goodman's vibration generator, operated by a.c. to make the fatigue measurements and by d.c. for direct tension. The fatigue tests were done at various very low temperatures at a given stress until 6.75×10^4 cycles of loading had been reached. The work hardening produced decreased with decreasing temperature down to 4.2°K. Specimens fatigued in boiling water showed less work hardening than those tested at room temperature. Further specimens were fatigued at room temperature and then heated to 100°C for periods of 60 and 90 min, after which stress—strain measurements were made at room temperature, and gave curves coinciding with those of the specimens fatigued at 100°C. These experiments show that an appreciable amount of work hardening anneals out at a comparatively low temperature, far lower than the annealing temperature of the work hardening introduced by unidirectional strain. The work hardening produced by fatigue, therefore, is different from that produced by tensile strain.
A.C.Whiffin

539.4.016 : 548.7

4817. WORK-HARDENING AND WORK-SOFTENING OF FACE-CENTRED CUBIC METAL CRYSTALS. A.Seeger, J.Diehl, S.Mader and H.Rebstock.
Phil. Mag. (Eighth Ser.), Vol. 2, 323-50 (March, 1957).

The present paper investigates by experiment and theory the mechanisms governing work-hardening, work-softening and slipband

formation in face-centred cubic metals. The rapid hardening stage (stage II) of the stress–strain curve is investigated by flow–stress measurements at different temperatures, combined tensile and torsion experiments, and by the observation of the length of slip lines as a function of prestrain. Stage III of the stress–strain curve and the work-softening phenomena associated with it are investigated with the electron microscope, showing that the principal surface patterns (slip bands, fragmentation) are due to cross slip. It is argued that in stage II the slip distance is decreased continually by the formation of Lomer–Cottrell dislocations. This also accounts for various observations on the end of the easy glide region. The temperature dependence of work-hardening in stage III is caused by screw dislocations circumventing the sessile Lomer–Cottrell dislocations by cross slip. The mechanisms through which cross slip causes glide-band formation and fragmentation are discussed in some detail. A.

539.434

4818. CONSTANT STRESS CREEP APPARATUS. R.C.Boettner and W.D.Robertson.
Rev. sci. Instrum., Vol. 27, No. 12, 1039-41 (Dec., 1956).

A simple creep apparatus for approximating a constant stress in tensile specimens of large cross-sections, where large applied loads are required, is described. The apparatus consists of a lever with a large built-in mechanical advantage, together with means for removal of incremental weights from the applied load. A.

539.501.08

4819. A MECHANICAL GARDNER MOBILOMETER. J.E.Roberts, A.J.Taylor and D.E.Woods.
J. sci. Instrum., Vol. 33, No. 12, 499-501 (Dec., 1956).

A mechanical counterpart of the Gardner mobilometer is described which gives results in agreement with those obtained on the hand-operated instrument and enables the rate of testing to be increased to sixteen determinations per hour. A.

539.56

4820. EXPERIMENTS ON CONTROLLED FRACTURES. J.J.Benbow and F.C.Roesler.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 201-11 (Feb., 1957).

A new type of fracture experiment is described. The specimen is a flat strip, which is split lengthwise by gradually propagating a crack down the middle. The crack is made stable in direction by holding the specimen in a state of lengthwise compression. The energy balance of the system can be established by simple beam theory. Given Young's modulus for the material, the fracture energy is found from the length of the crack and from its width at the open end. Measurements made on plastics, with specimens of varying size, show that the crack propagation is governed by a constant specific fracture energy, which is invariant with respect to scale transformations of the stresses. For a sample of polymethylmethacrylate the specific fracture energy was 4.9×10^5 dyn cm^{-1}. For a sample of polystyrene it was 25×10^5 dyn cm^{-1} for slow cracks, but dropped to 3×10^5 dyn cm^{-1} for fast-running cracks. A.

537.591.8 : 539.172

NUCLEAR DISINTEGRATIONS PRODUCED BY COSMIC RAY PARTICLES IN A HIGH PRESSURE CLOUD CHAMBER. See Abstr. 4694

539.6

4821. THE INFLUENCE OF TEMPERATURE ON METALLIC WEAR. J.K.Lancaster.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 112-18 (Jan., 1957).

The influence of temperature on the wear rate of a particular combination of metals, 60/40 brass on tool steel, has been investigated over the range 20°C to 600°C. Two regimes of wear were found. At low temperatures, extensive intermetallic contact and welding occur, and the wear rate increases with increasing temperature. At high temperatures, however, the wear rate decreases by several orders of magnitude and protective surface films are generated during sliding. The latter reduce both the extent of intermetallic contact and the frequency with which it occurs. A transition between these two regimes of wear also occurs at a critical load, the magnitude of which increases with the temperature. At loads above the transition load, the increase in wear rate with increasing temperature is accounted for by the associated decrease in hardness of the 60/40 brass, and the relationship $W = KL/P_m$ is obeyed, where W is the wear rate, L is the load and P_m is the flow pressure. At loads below the transition load, however, there is no definite relationship between the wear rate, load and flow pressure. It is suggested that in this regime of wear, the main effect of temperature arises from its influence on the reaction rate between the sliding metals and the surrounding atmosphere. A.

539.62

4822. THE ADHESION THEORY OF FRICTION. R.T.Spurr and T.P.Newcomb.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 98-101 (Jan., 1957).

It is shown that the static friction between a specimen of bituminous material and a cast iron disk is due to adhesion between specimen and disk, and that the friction is reduced when the normal load is removed because of elastic interaction between the surfaces. A.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.124 : 539.155.2

4823. NITROGEN ISOTOPIC FRACTIONATION BETWEEN NO AND NO_2 AND MASS DISCRIMINATION IN MASS ANALYSIS OF NO_2. G.M.Begun and C.E.Melton.
J. chem. Phys., Vol. 25, No. 6, 1292-3 (Dec., 1956).

During the analysis of some NO and NO_2 samples enriched in N^{15} a direct measurement of the equilibrium constant α for the exchange reaction between NO and NO_2 was made. The value of α determined was 1.028 ± 0.002. On comparing the 30/31 and 46/47 ratios no mass discrimination effect was found in the electron impact ionization of NO_2. Comparison is made with values of α calculated from spectroscopic data. H.C.Cole

541.124

4824. INDUCTION PERIOD IN UNI- BI- AND BI-UNIMOLECULAR CONSECUTIVE REACTIONS INVOLVING FAIRLY REACTIVE INTERMEDIATES. M.Talât-Erben.
J. chem. Phys., Vol. 25, No. 6, 1293-4 (Dec., 1956).

The fraction of steady-state concentration is calculated as a function of the extent of the reactions. For the same value of $(k_2/k_1)A_0$ the induction period of the uni-bi-type is greater than that of the bi-uni-type. W.Good

541.124

4825. DISPLACEMENT OF THE MAXIMUM IN THE CONCENTRATION-TIME DIAGRAM OF UNI-BI-, BI-UNI-, AND BI-BIMOLECULAR CONSECUTIVE REACTIONS. M.Talât-Erben.
J. chem. Phys., Vol. 26, No. 1, 75-7 (Jan., 1957).

As an extension of the results previously reported (Abstr. 2489/1956) for two first-order consecutive reactions, the expressions $k_1 \cdot t_{max}$ and $[B]_{max}/[A]_0$ are studied as functions of temperature and initial parent concentration for uni-bi-, bi-uni-, and bi-bimolecular consecutive reactions. A.

541.124

4826. PSEUDO-STATIONARY STATE APPROXIMATION IN CHEMICAL KINETICS. J.O.Hirschfelder.
J. chem. Phys., Vol. 26, No. 2, 271-3 (Feb., 1957).

In chemical kinetics it is customary to determine the concentrations of each of the free radicals and chemically unstable intermediates by assuming that these intermediates are in pseudo-stationary equilibrium with the principal chemical components. The mathematical nature of the pseudo-stationary approximation is examined and a method is developed for testing its validity or improving its accuracy in specific cases. In those cases where the rates of destruction of the intermediate compounds are rapid, the pseudo-stationary solutions are accurate. A.

541.126 : 539.215.4

4827. PARTICLE-SIZE EFFECTS IN EXPLOSIVES AT FINITE AND INFINITE DIAMETERS. M.E.Malin, A.W.Campbell and C.W.Mautz.
J. appl. Phys., Vol. 28, No. 1, 63-9 (Jan., 1957).

The effect of particle-size variations on the detonation velocity of the two-component solid explosive, Composition B, has been studied at various diameters and shown to be important. An attempt has been made to apply the diameter-effect theory of Eyring and that of Jones to explain the experimental data, but without complete success. Certain particle-size effects in Composition B have been shown to persist to infinite diameter, and a plausibility argument in terms of the Kirwood—Wood theory has been offered. The presence of large crystals in low-density RDX has been shown to lead to a "super velocity" which still prevails at infinite diameter. Experiments using large spheres of Composition B have been performed which also demonstrate a "super velocity" which may be related to the effect found in RDX. A.

541.126 : 534.222.2

4828. ON THE EXISTENCE OF STEADY-STATE DETONATIONS SUPPORTED BY A SINGLE CHEMICAL REACTION. W.W.Wood and J.G.Kirkwood.
J. chem. Phys., Vol. 25, No. 6, 1276-7 (Dec., 1956).

A von Neumann-type solution, requiring a Chapman—Jouguet condition involving the high-frequency value of the sound velocity, does not exist for a process involving a single reversible reaction. This does not apply for a more-than-one-reaction process. G.Allen

541.127 : 539.152.2

4829. CHEMICAL SHIFT IN NUCLEAR MAGNETIC RESONANCE PHENOMENON APPLIED TO STUDY THE KINETICS OF THE HYDROLYSIS OF ACETIC ANHYDRIDE. B.N.Bhar and W.Forsling.
Ark. Fys., Vol. 11, Paper 32, 405-15 (1957).

Chemical shift in nuclear magnetic resonance (n.m.r.) has been applied to study the kinetics of the hydrolysis of acetic anhydride using equimolecular quantities of the reactants. The quantity of acetic acid present at any time is calculated from chemical shift data from the n.m.r. experiment using Gutowsky and Saika's theory of chemical shift (see Abstr. 1814/1954). From the analysis of n.m.r. observations the specific reaction rate for a first-order reaction was found to be approximately 6×10^{-5} sec^{-1} at 27°C. The n.m.r. observations have been compared with an actual chemical analysis performed with the same concentrations of the reactants and at the same temperature. The n.m.r. and chemical experimental observations are in fair agreement during the first part of the reaction until the mole fraction of acetic acid formed is 0.5, after which the observations of the two experiments are in disagreement. The observations of the titration experiment are in better agreement with a second-order reaction than a first-order one. Causes of this disagreement are partly attributed to molecular association and complex formation in the reacting liquid system and to the approximate validity of Gutowsky and Saika's theory of chemical shift. The applicability of chemical shift effects in the n.m.r. phenomenon to studies of kinetics of chemical reactions have been discussed. A.

541.127 : 534.222.2

4830. RATE OF DISSOCIATION OF BROMINE IN SHOCK WAVES. H.B.Palmer and D.F.Hornig.
J. chem. Phys., Vol. 26, No. 1, 98-105 (Jan., 1957).

The rate of dissociation of bromine, pure and diluted with argon, was measured from 1200°K to 2225°K in shock waves, in order to study the mechanism of elementary reaction processes. The absorption coefficient of Br_2 was measured over the same temperature range. In the case of dissociation produced by Br_2—A collisions the reaction rate constant is reproduced over a range of 10^{27} by a collision theory equation. The activation energy is approximately equal to the dissociation energy of Br_2, the frequency factor is about 6% of that deduced from the collision frequency, and it appears that both the vibration and rotation of the Br_2 contribute energy to the dissociation. Br_2 is roughly twice as efficient as A in producing dissociation at high temperatures. For dissociation produced by Br_2—Br_2 collisions the measurements are in agreement with a rate constant in which the activation energy equals the dissociation energy, the steric factor is from 1% to 10% and five to seven square terms (e.g., the two vibrations and one to three rotations) contribute to the energy of dissociation. A.

541.127

4831. AN APPARATUS FOR INVESTIGATING THE LOW-PRESSURE OXIDATION KINETICS OF HOT METALS. L.G.Carpenter and W.N.Mair.
J. sci. Instrum., Vol. 34, No. 3, 110-14 (March, 1957).

An apparatus is described for measuring, by a continuous flow technique, the sorption of gas by a hot metal filament. The method is applicable to cases such as the oxidation of titanium in which sorption is so rapid that the "closed volume" technique cannot be used. It has the advantage that the assumulation of impurities in the reaction vessel is avoided. The data of a typical titanium oxidation experiment are given, together with a discussion of accuracy and sensitivity. The apparatus, which includes a simple manostat, is of general suitability for continuously introducing a metered gas flow of the order of 10^2 μ l/min into a low pressure system. The same apparatus may be used with closed volume technique for metals such as gold, which react very slowly with oxygen. A.

541.127 : 534.22

SOUND SPEED IN A REACTING MEDIUM. See Abstr. 4056

ELECTROCHEMISTRY 541.13

541.135.2

4832. CONDUCTANCE OF CONCENTRATED SOLUTIONS OF STRONG ELECTROLYTES. C.V.Suryanarayana and V.K.Venkatesan.
Nature (London), Vol. 178, 1461 (Dec. 29, 1956).

For solutions of NaCl, KCl, $NaNO_3$ and KNO_3 ranging from 1.00 molal to about saturation concentration a plot of Λ_c against $(1 - C_p)\eta_p$ is found to be linear, where Λ_c = specific conductance x $1000/C_p$; C_p = (moles of electrolyte per 1000 grams of water)/(moles of electrolyte per 1000 grams of water at saturation at the same temperature). W.Good

541.135.2

4833. ELECTRODEPOSITION OF THE ACTINIDE ELEMENTS. R.Ko.
Nucleonics, Vol. 15, No. 1, 72, 74-7 (Jan., 1957).

Quantitative deposition of the actinides can be achieved by electrolysis of acid solutions containing ammonium formate. Anodic oxidation of the formate reduces hydrogen ion concentration and allows quantitative deposition of the metal hydroxide. Full details are given of suitable conditions for the deposition of Th, Np, Pu, Am, and Cm. R.D.Smith

541.135.3 : 539.155.2

ISOTOPE ENRICHMENT BY COUNTERCURRENT ELECTROMIGRATION IN MOLTEN SALTS. See Abstr. 4647

541.135.5

4834. FREQUENCY VARIATION OF THE CAPACITY AND RESISTANCE OF THE ELECTRICAL DOUBLE LAYER AT A METAL—SOLUTION INTERFACE. J.O'M.Bockris, W.Mehl, B.E.Conway and L.Young.
J. chem. Phys., Vol. 25, No. 4, 776-7 (Oct., 1956).

The existence of this variation which recent data of the authors show is interpreted. It is pointed out that the evaluation of rate constants of electrode reactions by means of the a.c. method must be appropriately modified. W.Good

541.138

4835. EFFECTS OF ELECTROPOLISHING ON THE PHYSICO-CHEMICAL PROPERTIES OF THE SURFACE OF PURE ALUMINIUM. P.V.Schigolev.
Zh. fiz. Khim., Vol. 29, 682-4 (1955). In Russian. English translation in: Atomic Energy Res. Establ. (Harwell) Transl. No. 671, 4 pp. (1956).

The electropolishing is carried out in an alkaline phosphate bath at 90°m The anode current density was 3-3.5 A per square decimetre, the voltage 12-14 V at the terminals of the bath. The polishing produces an increase in the coefficient of reflection of light, and in the electrical resistance of the surface of the aluminium. Electron-microscopic investigation shows a cellular structure on the surface, and X-radiograms, besides the basic lines of aluminium exhibit new lines which, it is suggested, belong to some unknown modification of Al_2O_3. W.Good

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.143

4836. PHOTOLYTIC DARKENING AND ELECTRONIC RANGE IN AgCl. F.C.Brown and N.Wainfan.
Phys. Rev., Vol. 105, No. 1, 93-9 (Jan. 1, 1957).

Photolytic darkening and electron range were investigated for a series of silver chloride crystals cut from a single boule which was grown in vacuum by the Bridgman technique. The effect of annealing atmosphere on both the initial darkening rate and electron range is discussed. Darkening produced by absorption of light in the tail of the fundamental band is shown to have a volume and a surface component. The volume darkening produced in a vacuum-annealed crystal is capable of absorbing but not scattering light. The darkened crystal can be bleached selectively with high efficiency by exposure to light near the peak of the induced absorption band. Difficulty is found with interpreting the results entirely in terms of a classical theory for light absorption by colloidal particles suspended in a dielectric medium. Crystals annealed in air darken quite differently from vacuum-annealed samples and crystals heated in chlorine show little sensitivity to light. Somewhat smaller but regular differences in low-temperature electron range were found for the various crystals heat-treated in different annealing atmospheres. A.

541.143

4837. PHOTOLYTIC BEHAVIOR OF AgCl. N.Wainfan.
Phys. Rev., Vol. 105, No. 1, 100-2 (Jan. 1, 1957).

The photolytic darkening and bleaching of vacuum annealed AgCl was investigated at -100°C, -28°C, and room temperature. It was found that the shape of the absorption band induced by 416 mμ radiation is a function of the crystal temperature. The 580 mμ light, while initially bleaching the crystal selectively, was found to be able to completely destroy the induced colour in the crystals. No short-time photolytic effects were observed at -100°C. A.

541.15

4838. REACTIONS OF METHANE WITH IODINE ACTIVATED BY RADIATIVE NEUTRON CAPTURE. II. G.Levey and J.E.Willard.
J. chem. Phys., Vol. 25, No. 5, 904-7 (Nov., 1956).

For previous part, see Abstr. 515 (1953). Further experiments have been conducted to clarify the mechanism of the unique reaction whereby I^{128} freshly formed by the $I^{127}(n,\gamma)I^{128}$ process is able to replace hydrogen in methane ($I^{128} + CH_4 \rightarrow CH_3I + H$). They show that the yield of CH_3I^{128} is decreased by the presence of the inert gases He, A and Xe but not to the extent which would be the case if the activation energy for the reaction were supplied solely by kinetic energy of the I^{128}. I_2, CH_3I, C_2H_5I, C_3H_7I and NO, which have lower ionization potentials than that of the I atom are all more effective than the inert gases in reducing the yield. The organic yield of I^{128} is higher when alkyl iodides are used as the source of iodine than when I_2 is used. The ability of the freshly formed I^{128} to react with C_2H_6 or C_6H_6 is much less than with CH_4. Reactions of I_2 with CH_4 sensitized by argon and xenon occur when several hundred mm of the inert gas is present during exposures to 10^5r or more of gamma radiation. A.

541.15

4839. RADIATION-INDUCED OXIDATION OF ACETIC ACID–OXYGEN SOLUTIONS. W.M.Garrison, H.R.Haymond, W.Bennett and S.Cole.
J. chem. Phys., Vol. 25, No. 6, 1282 (Dec., 1956).

Aerated solutions of acetic acid containing C^{14} in the methyl or the carboxylic groups were exposed to a beam of 40 MeV helium ions. The formation of glycolic acid, glyoxylic acid, oxalic acid and of carbon dioxide was followed. The proportion of CO_2 derived from the methyl or the carboxyl group was determined. The G values for the various products were determined after three different radiation doses. No chain mechanism is postulated since not more than one molecule of acetic acid is decomposed per OH radical formed. The formation of the different acids is thought to go via the common precursor O_2CH_2COOH and not via consecutive oxidation steps.
M.Ebert

541.15

4840. COMMENTS ON THE IMPORTANCE OF ION–MOLECULE REACTIONS IN LIQUID-PHASE RADIATION CHEMISTRY.
R.H.Schuler.
J. chem. Phys., Vol. 26, No. 2, 425-6 (Feb., 1957).

It is suggested that carbon–carbon bond formation resulting from ion–molecule reactions may be fairly general. Examples are given. W.Good

DISPERSIONS. COLLOIDS. ADSORPTION 541.18

541.183.26

4841. STRUCTURE SENSITIVE CHEMISORPTION. G.Ehrlich and T.W.Hickmott.
J. chem. Phys., Vol. 26, No. 1, 219-20 (Jan., 1957).

The desorption of nitrogen from tungsten (1) as wire, (2) as rolled strip, has been studied by a spectrometer. (1) shows an α peak from 350° to 500°K and a β peak from 1400° to 2000°K but in (2) the α peak is smaller and the β peak, commencing now at 1100° is made up of two sections corresponding to two binding states. For β the heat of desorption was 110 kcal/mole with (2) and 75 kcal/mole for (1); the second β-state of (2) is caused by interaction of the first with the surface. The effect of surface structure on the strength of binding sites is emphasized. S.J.Gregg

CHEMICAL STRUCTURE 541.2/.6

541.51

4842. CONCERNING THE ELECTRON-WITHDRAWING POWER AND THE ELECTRONEGATIVITY OF GROUPS. R.W.Taft, Jr.
J. chem. Phys., Vol. 26, No. 1, 93-6 (Jan., 1957).

The polar substituent constants, σ*, obtained from reactivity considerations are discussed. Several qualitative relationships of σ* values to substituent constitution are established. These relationships relate quantitative correlations of the effect of structure on reactivity to concepts of bonding and electronegativity. The Mulliken concept of electronegativity is supported. The relativity large electron-withdrawing powers of Cl, Br, and I in bonds to carbon suggest the participation of the d orbitals of the valence shell. A discrepancy is noted between σ* values (and Mulliken's electronegativities) and the group electronegativities proposed by Dailey and Shoolery on the basis of proton nuclear magnetic resonance shifts in ethyl and methyl derivatives. A.

541.57

4843. CHEMICAL BOND: A ONE-DIMENSIONAL, SQUARE WELL-TYPE MODEL. G.M.Barrow.
J. chem. Phys., Vol. 26, No. 3, 558-62 (March, 1957).

A suitable bonding atomic orbital is generated by a square-well potential bounded by an infinite potential on one side and a constant finite potential on the other side. The bonding electrons of a σ-bond are described in a similar double-well potential. With a choice of the potential well dimensions and an electron repulsion term the electronic energy is calculated for various approximate wave-functions. For a heteronuclear bond the potential wells are given different depths. The additional energy and the ionic character are obtained. Comparison with the usual electronegativity scale and ionic character relations shows that this simple model reproduces the principal features of a σ-bond. A.

541.6 : 548

4844. VARIATION OF THE PHYSICAL PROPERTIES OF CRYSTALS WITH THEIR MOLECULAR CONCENTRATION.
P.A.Savintsev.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 5, 769-71 (1956). In Russian.

It is shown that for the alkali metal halides and the alkaline-earth metal oxides numerous properties (mechanical, thermal and electrical) vary in very much the same way with $\alpha = 1000D/M$, where D is the crystal density, and M is the molecular weight of the crystalline substance. R.C.Murray

541.64 : 536.46

4845. POSSIBLE POLYMER FORMATION BY STRONTIUM AND CALCIUM IN FLAMES. L.Huldt and E.Knall.
Ark. Fys., Vol. 11, Paper 12, 229-31 (1956). In German.

The optical thickness of acetylene–air flames containing Ca and Sr, measured by an arrangement which eliminates self-absorption and multiplies the actual thickness by 1.70-1.75, yields plots of intensity of the 4607 A line for Sr I and of the 4227 A line for Ca I against the logarithm of metal concentration in the flame which are practically coincident with those obtained directly, without any correction for self-absorption. Hence the linearity of these plots cannot be explained by self-absorption cancelling out the effects of formation of molecules like Sr_2, SrO, Ca_2, CaO, etc., and there is no such polymerization in the flames. R.C.Murray

541.64

4846. TRANSITION TEMPERATURES IN SOME POLYMERS BY DIFFERENTIAL THERMAL ANALYSIS. D.M.Chackraburtty.
J. chem. Phys., Vol. 26, No. 2, 427-8 (Feb., 1957).

In polyvinyl chloride there is a transition point at about 55° C with an exothermic reaction after which an endothermic reaction follows up to the melting point at about 130° C. In polyvinyl acetate there are transition points at 28°, 95° and 180° C reactions being all endothermic. W.Good

541.64 : 539.31

4847. VISCOELASTIC THEORY OF BRANCHED AND CROSS-LINKED POLYMERS. J.S.Ham.
J. chem. Phys., Vol. 26, No. 3, 625-33 (March, 1957).

A model of polymer chain motions is developed which in the limit of long, flexible chains can readily be applied to branched chain and cross-linked systems. The equation governing the motion of a chain takes the form of a differential equation rather than the form of the large set of difference equations that occur in most other treatments. The present model gives essentially the same distribution of relaxation times for linear polymers as previous treatments, and it also gives the same dependence of viscosity upon branching as the theories based on the effective radius of randomly coiled chains. In addition to this information, the theory yields the distribution of relaxation times for branched chain polymers, permitting, for example, the calculation of the energy stored in steady state shear. The relaxation time distribution of several models of a cross-linked polymer is also calculated, and the relationship of this distribution function to that of the uncross-linked materials is discussed. A.

541.64 : 538.222 : 539.152.2

4848. NUCLEAR MAGNETIC AND [PARAMAGNETIC] ELECTRON RESONANCE. TWO NEW METHODS FOR THE INVESTIGATION OF SYNTHETIC COMPOUNDS. W.Brügel.
Kunststoffe, Vol. 46, No. 8, 366-71 (Aug., 1956). In German.

A review. An introduction to the theory and technique of nuclear magnetic resonance spectroscopy is followed by a review of its application to polymer problems. The investigation of the degree of crystallinity and the nature of transitions in polymers is discussed. The use of paramagnetic resonance spectroscopy to study the effects of high energy radiation (e.g. γ-, X-rays) on polymers is also reviewed. G.Allen

541.653

4849. CONCERNING ALTERNANT HYDROCARBONS. W.Moffitt.
J. chem. Phys., Vol. 26, No. 2, 424-5 (Feb., 1957).

The calculation of the optical rotatory dispersion of hexahelicene was expedited by solving the LCAO-MO equations for 26 conjugated carbon atoms. These were factored into 12th- and 14th-order problems, and it now appears that each of the latter can be factored into two equivalent sets of 6th- and 7th-order systems, respectively. This procedure is not helpful when the molecule possesses a plane or twofold axis of symmetry bisecting bonds rather than containing carbon atoms. G.Allen

CHEMICAL ANALYSIS 543/545

543.7 : 539.16.08

4850. DETERMINATION OF Sr^{90} ACTIVITY IN WATER BY ION-EXCHANGE CONCENTRATION. C.W.Stanley and P.Kruger.
Nucleonics, Vol. 14, No. 11, 114, 117-18 (Nov., 1956).

Sr^{90} can be concentrated on a cation exchange resin at pH ≅ 7 and the Yt^{90} daughter eluted with ammonium citrate at pH ≅ 3. Alternatively, if interfering radioactivities are present, Sr can be removed at pH ≅ 6 and radiochemically purified. This method of concentration is superior to evaporation and filtration. R.D.Smith

545.827 : 539.172.4

4851. FAST NEUTRON ACTIVATION ANALYSIS. SILICON AND ALUMINUM. S.E.Turner.
Analyt. Chem., Vol. 28, No. 9, 1457-9 (Sept., 1956).

A rapid method for the quantitative estimation of silicon and aluminium uses the deuterium–tritium reaction as an intense source of 14 MeV neutrons. These neutrons are sufficiently energetic to produce the (n,p), (n,α) and (n,2n) reactions in usable yields at the neutron fluxes available from relatively low voltage positive ion accelerators. The (n,p) reaction on silicon, producing the 2.4 minute Al^{28} radioisotope, is used for silicon determination by comparison with yields from known samples. Similarly, aluminium determination uses the 15 hour Na^{24} activity produced by the (n,α) reaction. The method is accurate to within 5% for samples containing 0.4 g or more of silicon dioxide and 0.5 g or more of aluminium oxide. Phosphorus, praseodymium, and chromium interfere with the determination of silicon, while magnesium and iron interfere with the determination of aluminium. A.

CRYSTALLOGRAPHY 548

548.32

4852. THE EXISTENCE OF A METASTABLE PHASE ISOMORPHOUS WITH THE STABLE PHASE OF A PURE METAL. J.H.O.Varley.
Phil. Mag. (Eighth Ser.), Vol. 2, 384-8 (March, 1957).

A study of the factors controlling the coefficient of volume thermal expansion of a pure metal has led the author to the conclusion that there are two isomorphous states, differing only in volume, of any given crystal structure. In this paper the relative stabilities of these phases is discussed and the possibility of isomorphic transformations is examined. A satisfactory description of a paradoxical phase change observed by Bridgman in the case of caesium under high pressures is achieved. An isomorphic transition observed in cerium appears to be another example of this type of phase change which, under suitable conditions imposed by the external variables, pressure and temperature, and possibly composition in the case of alloys, is possible in all metals. A.

548.5 : 621.318.12

4853. A NOTE ON CRYSTAL FORMATION IN THE METALLIC OXIDES. L.R.Maxwell and S.J.Pickart.
Proc. Instn Elect. Engrs, Paper 2190R, publ. Oct., 1956 (Part B Suppl. No. 5, 152-3, 174-8).

Republication, with discussion, of the paper abstracted in Abstr. 1728 (1957).

548.52

4854. THE MIGRATIONS OF COPPER ATOMS ON THE SURFACE OF SILVER. R.B.Kehoe, R.C.Newman and D.W.Pashley.
Phil. Mag. (Eighth Ser.), Vol. I, 783-5 (Aug., 1956).

It is suggested that one particular specimen obtained in a series of experiments in which copper was condensed on to a smooth (111) silver surface, may throw light on the growth mechanism. The observations are in qualitative agreement with the mechanism suggested by Frenkel. E.W.Kellermann

548.52

4855. THE GROWTH OF LEAD NITRATE CRYSTALS FROM AQUEOUS SOLUTION. A.P.Williams.
Phil. Mag. (Eighth Ser.), Vol. 2, 317-22 (March, 1957).

Natural growth features observed on crystals of lead nitrate when growing from aqueous solution are described in detail. The modes of formation and behaviour of growth layers are discussed. A special feature is the frequent occurrence of stacking fault lines over which the growth layers cannot pass. These often appear at centres of growth. The effect of methylene blue as impurity in solution restricts the growth on the cube faces in a direction parallel to a diagonal in the face. This results in the formation of small striations or tilt faces. A.

548.52

4856. THE EPITAXIAL GROWTH AND OXIDATION OF NICKEL, COBALT AND IRON ON ROCKSALT. L.E.Collins and O.S.Heavens.
Proc. Phys. Soc. B., Vol. 70, Pt 3, 265-81 (March, 1957).

The structure and orientations of films of iron, nickel and cobalt, deposited by thermal evaporation on rocksalt, have been examined by electron diffraction. The oxides, forming spontaneously on the epitaxially grown metal films, have also been examined. The results are considered in the light of current theories of epitaxy and it is shown that the lattice misfit between substrate and deposit materials is generally less important than the maintenance of correct coordination of atoms in the first layer. Generally no evidence of a strained deposit lattice was obtained except in the case of iron oxide films on iron. A.

548.523 : 537.226.2

4857. PREPARATION AND PROPERTIES OF SINGLE CRYSTALS OF SOLID SOLUTIONS OF BARIUM AND LEAD TITANATES AND OF SINGLE CRYSTALS OF LEAD TITANATE. M.L.Sholokhovich, E.G.Fesenko, O.P.Kramarov and A.L.Khodakov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 5, 1025-8 (1956). In Russian.

Melting isotherms in the KF—$BaTiO_3$—$PbTiO_3$ system were determined up to ~950° C and conditions for growing titanate crystals studied. The largest obtained were brown-coloured irregular cubes of up to 1 mm edge. Some of the smaller crystals produced were bright yellow and well formed. Loss of PbO and $PbTiO_3$ by volatilization was troublesome and a viscous flux $Pb(BO_2)_2$ was tried so as to reduce it. Melting curves for this with $PbTiO_3$ and $PbTiO_3$. PbO both showed minima near 90 mol.% $Pb(BO_2)_2$ and 640° C. Well formed bright yellow $PbTiO_3$ crystals, 1-2 mm cubes, density 7.3 g/cm^3, refractive index 2.71, were grown. The Curie point of a crystal grown from a KF-fluxed 50% $BaTiO_3$ 50% $PbTiO_3$ melt was 190° C, which by comparison with polycrystalline specimens suggested a $PbTiO_3$ content of 18.5%. This difference in composition of initial melt and crystal was ascribed to loss by volatilization. At 25° C dielectric constant was 380. Structure at 20° C was perovskite type with a = 3.965 c = 4.037 A. —
C.H.L.Goodman

548.53

4858. THE LOW-TEMPERATURE RECRYSTALLIZATION OF METALS. P.I.Garber, I.A.Gindin, V.S.Kogan and B.G.Lazarev.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 1, 64-6 (1956). In Russian.

The room temperature recrystallization of technical iron and nickel after deformation at liquid nitrogen temperature was studied by X-ray and microscopic techniques. Deformation was by rolling or by the forced expansion of thin-walled tubes. Initial grain size was either 25-30 or 100-200 μ. Recrystallization gave appreciable grain refinement particularly for the coarser-grained specimens and required relatively small deformation (i.e. reduction < 20%). The suggested sources of energy for the recrystallization process were lattice strains associated with slip. Twinning, which occurred in Fe but not in Ni, appeared to have no effect. C.H.L.Goodman

548.57

4859. SOME GROWTH PATTERNS ON Cd CRYSTALS. F.Blaha.
S.B.Österr. Akad. Wiss. IIa, Vol. 164, No. 8-10, 443-53 (1955). In German.

Single crystals of different crystallographic forms, deposited from the vapour phase along the inner surface of a glass tube of varying diameter, the lower end of which contains 99.999% pure liquid Cd and the colder upper end is connected to a vacuum pump, are illustrated and discussed. Also crystals grown from the melt by the Czochralski method in a reducing atmosphere are similarly discussed. Various stages in the drawing process are illustrated. An explanation is given of the formation of wedge-shaped lamellae on the base plane. The appearance of the surfaces of the crystals is considerably dependent on the purity of the metal. S.Weintroub

548.574

4860. A MICROSCOPE STUDY OF ETCHED GERMANIUM SURFACES. M.Kikuchi and S.Denda.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1127 (Oct., 1956).

Etchpits with terrace structures were obtained with etches containing HCl and HNO_3. The terrace spacing may vary considerably in pits produced on the same surface. J.Franks

548.574

4861. SPIRAL ETCH PITS ON GERMANIUM SURFACE. M.Kikuchi and S.Denda.
J. Phys. Soc. Japan, Vol. 12, No. 1, 105 (Jan., 1957).

Reports left and right-hand spiral etch pits on (111) germanium surfaces as revealed by a HNO_3/HF/HCl/H_2O_2 etching solution. The density of such pits is 100-1000 times smaller than normal pits on (111). C.A.Hogarth

ATOMIC AND X-RAY CRYSTALLOGRAPHY

548.7

548.7

4862. DISORDERED ONE-DIMENSIONAL CRYSTALS. H.Schmidt.
Phys. Rev., Vol. 105, No. 2, 425-41 (Jan. 15, 1957).

A mathematical method is developed which gives fairly generally the density of eigenstates for one-dimensional disordered systems. The method is applied first to a disordered linear chain of elastically coupled masses. The results for the energy spectrum are closely related to those obtained by Dyson. The electronic energy-states in a one-dimensional disordered crystal are considered, represented by a series of δ-function potentials of different strengths, randomly distributed. The resulting functional equation is solved explicitly in that case which corresponds to a uniform crystal with a small amount of impurities; that is, the shape of the impurity bands is found. A.

548.7

4863. INTERACTION OF VIBRATIONS IN NON-POLAR CRYSTALS WITH ELECTRIC FIELDS. V.S.Mashkevich and K.B.Tolpygo.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 3, 575-7 (1956). In Russian.

The observed infrared lattice absorption in homopolar crystals (diamond, Si, Ge) is not predicted by the theory of the Born lattice but appears to arise from effects similar to those observed in ionic crystals. The energy of a homopolar lattice is expressed in terms of the displacements of the nuclei and the dipole moments of the electronic shells. As well as three acoustic and three optical modes, two additional solutions are found (defined as "light" modes) for which the nuclei remain stationary and the dipole moments are not equal to zero. A temperature dependence of mobility is derived, viz. for acoustic modes $T^{-3/2}$ and for optical modes $\exp(h\nu_0/kT)$ at low temperatures and $T^{-3/2}$ at high temperatures, where the symbols have their usual meanings. J.B.Arthur

548.7

4864. IMPURITY-INDUCED LOCALIZED MODES OF LATTICE VIBRATION IN A DIATOMIC CHAIN. R.L.Bjork.
Phys. Rev., Vol. 105, No. 2, 456-9 (Jan. 15, 1957).

The normal modes of vibration and their associated frequencies are found for a diatomic chain containing an impurity of different mass and force constant than the atom which it replaces. Localized modes are found which have appreciable components only near the impurity and whose frequencies are displaced from the continua of the optical and acoustic bands into the forbidden gap or above the optical band. The number of localized modes, their general position (forbidden gap or above optical), and their symmetry (odd or even), engendered by any impurity are presented graphically. It is shown that when a strongly localized mode is present, other modes avoid the impurity. A.

548.7

4865. EFFECT OF FREE ENDS ON THE VIBRATION FREQUENCIES OF ONE-DIMENSIONAL LATTICES. R.F.Wallis.
Phys. Rev., Vol. 105, No. 2, 540-5 (Jan. 15, 1957).

Vibration frequencies have been calculated for finite one-dimensional lattices in which the point masses alternately have the

values m_α and m_β, $m_\alpha < m_\beta$. Only nearest neighbour Hooke's law interactions are considered. The end atoms are assumed to interact only with their nearest neighbours on the interior of the lattice and are otherwise free. If the numbers of atoms having masses m_α and m_β are equal, there exists a single mode whose frequency squared lies at the middle of the "forbidden" gap between the optical and acoustical branches. For this "surface" mode the displacements of the atoms from their equilibrium positions decrease roughly exponentially from the end having the lighter atom. For the case of N atoms of mass m_β and N + 1 atoms of mass m_α there exist two modes whose frequencies lie in the "forbidden" gap provided $(m_\alpha/m_\beta) < N/(N + 1)$. These modes correspond to symmetric and antisymmetric displacements. The displacements are largest for the end atoms and decrease roughly exponentially toward the centre of the lattice. A.

548.7

4866. THE RELATION BETWEEN THE PARAMETERS OF LONGITUDINAL AND TRANSVERSE OPTICAL OSCILLATIONS OF THE IONS IN A CRYSTAL. M.A.Krivoglaz and S.I.Pekar.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 343-6 (1956). In Russian.

Oscillations with $10^{-7} < \lambda < 10^{-3}$ cm are considered so that the field of the oscillating ions can be regarded as electrostatic. Relations between the proper frequencies are then derived which then take a particularly simple form if there are only two ions per cell. A.L.Mackay

548.7

4867. BRILLOUIN ZONES. [De Brillouin'ska zonerna.] T.Stubb.
Helsinki: State Institute of Technical Research (1955) 22 pp.
In Swedish.

This work attempts to explain in a clear way the Brillouin zones using classical mathematics in order to avoid the difficulties which are connected with the group-theoretical treatment. The zones with two-dimensional lattices have been treated at length and the three-dimensional problems superficially. The Bloch wave-function has been derived quantum-mechanically in a way which only requires knowledge of Dirac's expansion theory and the quantum-mechanical constants of motion. In this case the proof becomes completely mathematical because these constants of motion have no mechanical analogies. A.

548.7

4868. ION PAIRING IN SOLIDS. J.S.Prener.
J. chem. Phys., Vol. 25, No. 6, 1294 (1956).

The Reiss theory of the formation of ion pairs in electrolyte solutions is adapted to some similar problems arising in crystals. Using the Reiss distribution function (Abstr. 8840/1956), an approximate expression for the corresponding crystal distribution function is obtained and some numerical values are given for cubic ZnS. There is fair agreement with the mass action law description of ion pair formation. A.B Lidiard

548.7

4869. ELECTRONIC BAND STRUCTURE OF SELENIUM AND TELLURIUM. J.R.Reitz.
Phys. Rev., Vol. 105, No. 4, 1233-40 (Feb. 15, 1957).

The band structure of selenium and tellurium has been calculated according to the tight-binding scheme in which only nearest neighbour interactions are presumed to be important. As a first approximation, von Hippel's hypothetical crystal with 90° bond angles between bonds in the chain is used, and the ninth degree secular equation for the p bands factors into three identical cubic equations. Next, the crystal is pulled out along the c axis to the observed bond angle, and further splitting of the p bands is calculated as a perturbation. The fifteen d bands are also computed, and mixing of p and d levels estimated. In addition, matrix elements for optical transitions between bands have been worked out. The long-wavelength absorption limit for direct transitions occurs at $k_z = \pi/c$, and is different for light polarized parallel or perpendicular to the c axis of the crystal. Both $p \rightarrow p$ and $p \rightarrow d$ transitions give the same order for the two absorption edges, the results appearing to be in accord with experiments of Loferski on tellurium. Finally, Bridgman's measurements on crystals of tellurium subjected to hydrostatic pressure are noted: the bond angle apparently increases with pressure. The calculations here show a reduction in energy gap with increasing bond angle (i.e., increasing pressure), which is in the right direction to explain the simultaneous large decrease in electrical resistivity observed by Bridgman. A.

548.7

4870. HOMOPOLAR EFFECTS IN CRYSTALS HAVING THE SODIUM CHLORIDE TYPE OF LATTICE. T.B.Grimley.
Proc. Phys. Soc. A, Vol. 70, Pt 2, 123-33 (Feb., 1957).

In an ionic crystal, the outer electrons from the negative ions will be shared to some extent with the surrounding metal ions. Allowing for this possibility in constructing approximate solutions of Fock's equations for the valence electrons, it is shown that the expression for the lattice energy contains an extra negative term representing the homopolar contribution. Numerical calculations are made for LiF and it is found that the homopolar contribution is only about 0.1% of the lattice energy. It is also shown that, whilst homopolar effects provide an additional source of attraction between nearest (unlike) neighbours, they enhance the repulsion between like neighbours. A

548.7 : 539.11

4871. THE MAGNETIC ENERGY LEVELS OF ELECTRONS IN METALS. A.D.Brailsford.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 275-87 (April, 1957).

The magnetic energy levels of an electron in a periodic lattice are found using a generalization of the energy band of the simple cubic lattice. It is shown that when the constant-energy curves in a plane normal to the field direction are closed the levels are given by the semi-classical quantization rules, the broadening due to the lattice forces being negligible compared with the level spacing in nearly all cases. When the curves are open, the levels in the presence of a magnetic field are continuous. The relation of the results to a general type of energy band is briefly discussed. A.

548.7

4872. THE INTERACTION OF ELECTRONS WITH LATTICE VIBRATIONS. P.G.Harper.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 390-2 (April, 1957).

Simultaneous equations are derived for the frequency and zero-point energy of normal modes of lattice motion resulting from the electron–lattice interaction.

548.7

4873. INTERACTION BETWEEN AN ELECTRON HOLE AND LATTICE OSCILLATIONS IN A HOMOPOLAR CRYSTAL.
K.B.Tolpygo and A.M.Fedorchenko.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 845-53 (1956). In Russian.

Motion of a hole in a homopolar crystal of the diamond type is considered on the basis of the many-electron Schrödinger equation. The presence of a hole was taken into account by replacing a single pair bond by a one-electron bond, with the result of an additional force which tends to deform the crystal. The corresponding term in the Hamiltonian was interpreted as the interaction between the hole and the lattice dislocations. The significance for the problem of autolocalization of the hole of the forces which thus arise, the e scattering of current carriers by lattice vibrations and the theory of mobility, the thermo-e.m.f. and the Nernst effect, are also discussed. A.

548.7 : 539.153.4

4874. GROUP THEORY METHOD IN THE QUANTUM PHYSICS OF A SOLID BODY. (POINT SYMMETRY). A.V.Sokolov and V.P.Shirokovskiĭ.
Uspekhi. fiz. Nauk, Vol. 60, No. 4, 617-88 (1956). In Russian.

Survey paper. General principles are set out which can be applied to the investigation of any quantum-mechanical system and which will give fuller results the higher the symmetry of the problem. Applications to three problems: the hydrogen atom, electron states in a crystal lattice, a selection rule — are developed at some length. C.R.S.Manders

548.7

4875. ELECTRON SPIN RELAXATION TIMES IN GADOLINIUM ETHYL SULFATE. G.Feher and H.E.D.Scovil.
Phys. Rev., Vol. 105, No. 2, 760-2 (Jan. 15, 1957).

From saturation experiments, measurements are made of the relaxation times of Gd transitions in the electron resonance spectrum of a single crystal of La ethyl sulphate containing 1 : 200 parts of Gd and 1 : 500 of Ce at 1.2°K and 9000 Mc/s. When the crystal is oriented so that the - 3/2 to - 1/2 transition is equal in frequency to a Ce transition T_1 for the Gd transition decreases by a factor of 7 since energy is returned to the lattice via a spin exchange with the Ce. D.H.Whiffen

548.7 : 538.561

4876. OPERATION OF A SOLID STATE MASER. H.E.D.Scovil, G.Feher and H.Seidel.
Phys. Rev., Vol. 105, No. 2, 762-3 (Jan. 15, 1957).

Using a single crystal of La ethyl sulphate with 0.5% Gd and 0.2% Ce a solid-state maser has been successfully operated in the manner suggested by Bloembergen (Abstr. 1181/1957). A single 90 mg crystal is placed in a cavity simultaneously resonant at 17.52 kMc/s and 9.06 kMc/s at 1.2°K. The 17.52 kMc/s radiation

saturates the Gd - 5/2 → −1/2 transition and with the field orientation (see preceding abstract) in which the −1/2 → −3/2 relaxation is increased by being equal to a Ce transition so that it is ten times faster than the −3/2 → −5/2 relaxation then the population of the −3/2 level builds up until it exceeds that of the lower lying −5/2 level and spontaneous emission of the −3/2 → −5/2 transition occurs at 9.06 kMc/s. The system thus oscillates at this frequency and under power conditions when oscillations do not occur spontaneously the system acts as an amplifier for 9.06 kMc/s. With 200 mW 17.52 kMc/s power the oscillator produced 15 μW at 9.06 kMc/s.
D.H.Whiffen

548.7

4877. PARAMAGNETIC RESONANCE SPECTRUM OF CURIUM.
P.Fields, A.Friedman, B.Smaller and W.Low.
Phys. Rev., Vol. 105, No. 2, 757 (Jan. 15, 1957).

The paramagnetic resonance spectrum of a single crystal of $LaCl_3$ with 1 part in 2000 of Cm shows 7 fine structure lines confirming the $(5f)^7$, $^8S_{7/2}$ ground state. $g = 1.9914 \pm 0.0008$ and the Hamiltonian parameters $b_2^0 = 8.2 \pm 0.2$ gauss, $b_4^0 = 2.2 \pm 0.2$ gauss and $(b_6^6 - 5b_6^0) \geq 3.7 \pm 0.5$ gauss. Alpha-radiation damage caused the signal to disappear in 24 hr.
D.H.Whiffen

548.7 : 539.152.2

4878. PARAMAGNETIC RESONANCE AND OPTICAL ABSORPTION SPECTRA OF Cr^{3+} IN MgO. W.Low.
Phys. Rev., Vol. 105, No. 3, 801-5 (Feb. 1, 1957).

The paramagnetic resonance spectrum of the trivalent chromium ion has been detected at a wavelength of 1.2 cm. The spectrum is isotropic with one line at $g = 1.9800 \pm 0.0006$. The hyperfine structure of the Cr^{53} isotope in its natural abundance was detected. The hyperfine structure constant $A = (1.60 \pm 0.03) \times 10^{-4}$ cm^{-1} permits an evaluation of the nuclear magnetic moment as 0.475 nm. The narrow line and the failure to observe any ground state splitting show the trivalent chromium ion is exposed to a very pure cubic field. There is no indication of associated vacancies with the Cr^{3+} ion. Optical absorption lines were found at 16 000, 22 700, and 29 700 cm^{-1} as well as a beginning of absorption at 46 000 cm^{-1}. The 16 000 cm^{-1} line is caused either by a quartet-doublet transition or by the Cr^{2+} ion. The other absorption lines can be fitted with $Dq = 2270$ cm^{-1} and the ^4P state at 10 000 cm^{-1} above the ^4F state. An analysis of the paramagnetic and optical absorption spectra indicate very strong crystal field and some covalent bonding. Probably the Cr^{3+} and the surrounding six oxygen atoms have to be regarded as a very tightly knit unit.
A.

548.7

4879. PARAMAGNETIC RELAXATION IN MONOCRYSTALS OF SOME SALTS OF ELEMENTS OF THE IRON GROUP.
T.I.Volokhova.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 889-90 (1956). In Russian.

For single crystals of $CuSO_4.5H_2O$ electron resonance shows an anisotropy in the line-width and in the spin–lattice relaxation time. The magnetic heat capacity given by $\delta^2/0.41$, where δ is the half-width, is 0.4×10^6 Oe^2 when H_0 is parallel to the magnetic axis and 0.6×10^6 Oe^2 for perpendicular directions. The spin–lattice relaxation time varies slightly with field increasing from 1.0×10^{-8} to 4.0×10^{-8} sec for the perpendicular cases and from 0.5×10^{-8} to 2.0×10^{-8} when H_0 is parallel and the fields are increasing from 800 to 5600 Oe. $MnSO_4.4H_2O$ and $Fe(NH_4)(SO_4)_2.12H_2O$ show no anisotropies and have heat capacities 6.3×10^6 and 0.28×10^6 Oe^2 respectively.
D.H.Whiffen

548.7

4880. THE EXCITATION SPECTRUM OF EXCITONS IN A SOLID BODY. E.F.Gross.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 20, No. 1, 89-104 (1956). In Russian.

An extensive survey of observations of exciton spectra in Cu_2O at various temperatures down to 1.3°K by the author and other workers leads to the conclusion that an exciton resembles a complex atomic structure rather than a simple hydrogen-like atom, based on the following observations: (1) a deviation in frequency of the first few members of the yellow series from that predicted by a hydrogen-like dependence, the deviation decreasing with increasing quantum number; (2) the appearance at helium temperature of weak lines between those of the yellow series, which do not fit the hydrogen-like law; (3) the behaviour of the yellow lines under an external field (Stark effect), which differs from that of the spectral lines in the hydrogen atom.
J.B.Arthur

548.7

4881. OPTICAL SPECTRUM DUE TO THE FORMATION OF EXCITONS IN CRYSTAL LATTICES. E.F.Gross.
J. Phys. Radium, Vol. 17, No. 8-9, 815-16 (Aug.-Sept., 1956). In French.

548.7 : 535.345

4882. STUDY OF EXCITON SPECTRA AT VERY LOW TEMPERATURES. S.Nikitine.
J. Phys. Radium, Vol. 17, No. 8-9, 817-19 (Aug.-Sept., 1956). In French.

An account is given on the results obtained on the absorption spectra of a number of crystals at very low temperatures. In most cases it has been found that the absorption spectra give evidence of narrow line structure. The breadth of some of these lines does not exceed one angstrom or even less. Sometimes they form hydrogen like series which are in several compounds accompanied by vibration satellites. In anisotropic crystals the absorption lines are dichroic. These results are believed to give an experimental evidence for the existence of excitons.
A.

548.7 : 535.345

4883. REMARKS CONCERNING THE EXCITON SPECTRUM.
G.Perny.
J. Phys. Radium, Vol. 17, No. 8-9, 820 (Aug.-Sept., 1956). In French.

548.7

4884. THEORY OF EXCITONS IN POLAR CRYSTALS. H.Haken.
J. Phys. Radium, Vol. 17, No. 8-9, 826-8 (Aug.-Sept., 1956). In French.

The interaction between the excitons and the lattice vibrations has been studied in a new way. The wave-functions use the one-particle functions of polaron theory. The resulting formulation describes the electron and the hole as electrodynamically-coupled particles, the effective mass of which is given by the polaron theory.
A.

548.1

4885. STRUCTURE OF THE EXCITON OF KCl. T.Muto and H.Okuno.
J. Phys. Radium, Vol. 17, No. 8-9, 829-30 (Aug.-Sept., 1956). In French.

548.7

4886. ELECTRONIC STRUCTURE OF A MOVING EXCITON IN ALKALI HALIDES. T.Muto and S.Oyama.
J. Phys. Soc. Japan, Vol. 12, No. 1, 101 (Jan., 1957).

The solutions of a Wannier–Slater equation obtained previously are made use of as one-electron orbitals in the solution of the moving exciton problem.
C.A.Hogarth

548.

4887. ON THE ELECTRONIC STRUCTURE OF LOCALIZED EXCITON IN ALKALI CHLORIDES. T.Muto and H.Okuno.
J. Phys. Soc. Japan, Vol. 12, No. 1, 108 (Jan., 1957).

The procedure developed in previous work on KCl is extended to LiCl, NaCl, RbCl, and CsCl, and the results for energy are in good agreement with experimental data.
C.A.Hogarth

548.

4888. APPLICATION OF FEYNMAN'S NEW VARIATIONAL PROCEDURE TO THE CALCULATION OF THE GROUND STATE ENERGY OF EXCITONS. H.Haken.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1608-9 (Dec., 1956).

Reports calculations of the ground-state energy of an exciton in a polar crystal (interaction with optical phonons included) based on the use of "trial" Hamiltonians (1) corresponding to a Coloumb electron–hole interaction, (2) corresponding to a harmonic electron–hole interaction, (3) using Feynman's method of the auxiliary particle. The result of Meyer (Abstr. 4086/1956) corresponds to a special case of (1) and the result of Dykman and Pekar (Abstr. 5779/195 to a special case of (2). Detailed results are not given in this note.
A.B.Lidiar

548

4889. THEORY OF EXCITONS IN IONIC CRYSTALS.
I.P.Ipatova.
Zh. tekh. Fiz., Vol. 26, No. 12, 2786-8 (1956). In Russian.

Using the method of intermediate coupling developed by Lee, Low and Pines (Abstr. 4475/1953) the energy is expressed in terms of the effective masses of electron and hole. Numerical evaluation leads to results qualitatively different from those of Dykman and Pekar (Abstr. 5779/1953).
R.F.S.Hearm

548.7

4890. ABSORPTION OF LIGHT IN ALPHA SiC NEAR THE BAND EDGE. W.J.Choyke and L.Patrick.
Phys. Rev., Vol. 105, No. 6, 1721-3 (March 15, 1957).

The absorption in alpha SiC of photons of energy 2.6 eV to 3.3 eV has been measured at temperatures from 77°K to 717°K. The measurements show that the interband transitions are indirect, requiring the absorption or emission of a phonon of energy 0.09 eV. The minimum energy gap is found to be 2.86 eV at 300°K, and above this temperature $dE_G/dT = -3.3 \times 10^{-4}$ eV/degree. A.

548.7 : 535.43

4891. LIGHT-SCATTERING AND COLOR CENTERS IN SODIUM CYANIDE. G.Isetti and T.J.Neubert.
J. chem. Phys., Vol. 26, No. 2, 337-44 (Feb., 1957).

Single crystals of sodium cyanide show no absorption in the region 10 000-3000 A, but there is a strong absorption which begins at ~ 2350 A. In the intermediate region there is a prominent absorption at 2725 A in some crystals. The absorption at 2725 and that which begins at 2350 A are conceded to be due to impurities. For crystals measured (10 000-3200 A) at room temperature the optical density varies with the inverse fourth power of wavelength, thus indicating the presence of light-scattering centres small in extent compared to the wavelength of light. It is suggested that the scattering centres are small regions of rhombohedral phase embedded in the averaged face-centred cubic phase usually observed at room temperature. The possibility that the scattering centres are due to coagulated impurities, however, cannot be excluded. When NaCN is cooled to 0° C the CN^- ions become aligned, the structure changes from cubic to orthorhombic and the light-scattering is very much enhanced. At 0° C the optical density varies, in some cases, with the inverse second power of the wavelength and indicates that the scattering centres are large compared with the wavelength of light. In this case the scattering centres are thought to be related to the mosaic block structure of the crystal. Upon X-irradiation, NaCN colours only with difficulty. Absorptions are observed at 5400, 4570, and 3600 A, together with a general increase in absorption at shorter wavelengths. The 4570 A band may be the F band. The coloration is very unstable, bleaching at 30° with a half-time of ~ 27 min. At 0° C the coloration is more stable than would have been predicted on the basis of high temperature data, and it is, therefore, suggested that the instability is related to the occasional reorientation of CN^- ions which must occur at $T > 15°$ C. A.

548.7

4892. ELECTRIC POLARIZABILITY OF COLOUR CENTRES IN QUARTZ CRYSTALS AND GLASSES. J.Volger and J.M.Stevels.
Philips Res. Rep., Vol. 11, No. 1, 79-80 (Feb., 1956).

Interprets dielectric relaxation losses which have recently been observed in irradiated quartz crystals at low temperatures. The losses are associated with colour centres and it is suggested that the electron orbit at the colour centre is not spherically symmetrical, but localized near one of the cations surrounding the anion vacancy. Transitions between the various cation sites, which are nearly equivalent in energy, give rise to the observed polarizability and loss. In glass, although colour centres are produced by irradiation, the dielectric effect is absent. This may be due to the lack of crystal symmetry disturbing the chance of transitions between equivalent positions. K.W.Plessner

548.7

4893. HYPERFINE STRUCTURE OF F-CENTER SPIN RESONANCE IN LITHIUM FLUORIDE AND SODIUM FLUORIDE. N.W.Lord.
Phys. Rev., Vol. 105, No. 2, 756-7 (Jan. 15, 1957).

F-centres induced in NaF and LiF by X-rays show resolved hyperfine structure in their resonance lines at 9000 Mc/s, 3000 gauss. These are due to neighbouring nuclear spins and the pattern fits a vacancy F-centre model with coupling to the metal greater than to F. Numerical details are given. D.H.Whiffen

548.7 : 538.22

4894. SOME F-BAND OPTICAL OSCILLATOR STRENGTHS IN ADDITIVELY COLORED ALKALI HALIDES. C.J.Rauch and C.V.Heer.
Phys. Rev., Vol. 105, No. 3, 914-20 (Feb. 1, 1957).

The number of magnetic centres in alkali halides additively coloured in the alkali vapour has been determined by measuring the static magnetic susceptibility. Curie's law is followed, and the measurements have been extended to liquid helium temperatures to increase the sensitivity. The number of centres is compared with the optical absorption of the F-band. Under the assumptions that the F-centre electron wave-function depends parametrically upon the coordinates of the surrounding nuclei, the electric dipole matrix element is independent of the nuclear coordinates, and the electric field at the electron is the Lorentz local field, the optical oscillator strengths for a Lorentz, Gaussian, and observed line shape are determined. The average for a series of experiments yield $f_L = 0.66$ for KCl, $f_L = 0.71$ for KBr, and $f_L = 0.46$ for KI. Values for CsBr and NaCl are discussed. A.

548.7

4895. NEUTRON SPECIFIC COLOR CENTER IN FUSED SILICA AND AN IMPURITY BAND OF IDENTICAL WAVELENGTH. A.J.Cohen.
Phys. Rev., Vol. 105, No. 4, 1151-5 (Feb. 15, 1957).

A colour centre at 242 mμ is produced in certain specimens of fused silica only by pile irradiation and not by X-ray, high energy electron, or proton bombardment. It is removed by heating to 700° C and can be reintroduced only by pile irradiation. The significance of an impurity absorption band already reported in fused silica at the same wavelength is discussed. An intense band appears in rather pure optical-quality fused germanium dioxide centred at 245 mμ and is due to the same reduced germanium species that causes the 242 mμ impurity band in fused silica. A.

548.7

4896. COLOR CENTERS IN X-RAYED POTASSIUM IODIDE. H.N.Hersh.
Phys. Rev., Vol. 105, No. 4, 1158-67 (Feb. 15, 1957).

Single crystals of potassium iodide have been irradiated with X-rays at room, liquid nitrogen, and liquid helium temperatures. Only a neglibible F-centre production occurs at liquid helium temperatures, whereas a greatly increased rate prevails at normal temperatures. A number of new absorption bands have been found to occur at liquid helium temperature, whereas the room and liquid nitrogen temperature spectra are much simpler. At least two of these bands are shown to be associated with impurities. Spectra are presented which show the initial existence of centres with absorption bands near the fundamental absorption edge in the unirradiated crystal Evidence is presented which shows that the initial effect of irradiation is to lower the absorption in the long-wavelength tail of the fundamental absorption band, presumably by radiation damage of those nonequilibrium aggregates initially present in the crystal. More certain purity is required for further studies. A.

548.7

4897. APPROXIMATE WAVE FUNCTIONS FOR THE F CENTER, AND THEIR APPLICATION TO THE ELECTRON SPIN RESONANCE PROBLEM. B.S.Gourary and F.J.Adrian.
Phys. Rev., Vol. 105, No. 4, 1180-92 (Feb. 15, 1957).

The vacancy model of the F-centre is treated by a simplified Hartree method. The ions are treated as point charges, and the potential of the lattice is computed. The simplified Hartree equation is solved variationally, and the electronic polarization is computed by a self-consistent method which takes account of the screening action of the F-centre electron. The lattice distortion is then calculated. The resulting energies are compared with the available optical data. The agreement is good. The hyperfine structure of the F-centre is computed, using a determinantal wave-function. The predicted hyperfine splittings agree fairly well with the experimental results of Lord and Jen on the resolved hyperfine structure of LiF. The effects of exchange and overlap are also discussed. A.

548.7

4898. R-CENTER PRODUCTION IN ALKALI HALIDES. G.R.Cole and R.J.Friauf.
Phys. Rev., Vol. 105, No. 5, 1464-5 (March 1, 1957).

The suggestion that both the R_1 and R_2 bands in coloured KCl crystals may be due to transitions of the F_2 centre is considered. Formation mechanisms in support of this view are presented which are consistent with (1) the behaviour of the R and M bands during F-light irradiation, (2) the observed decrease of the R bands and increase of the M band produced by heating, and (3) the photoconductivities measured for the R_1 and R_2 bands. A.

548.7

4899. COLOUR CENTERS AND X RAY SPECTRA OF POTASSIUM HALIDE CRYSTALS. A.N.Nigam.
Z. Phys., Vol. 147, No. 3, 264-70 (1957).

Possible correlations of the energy levels arising due to colour centres in a potassium halide crystal with the X-ray absorption fine structure of the potassium ion are discussed. Influence of the inner ionization on the activation energy of the ions and on the potential surrounding them has been estimated using approximate equations. A.

548.7

4900. EFFECT OF IMPURITY IN NUCLEAR QUADRUPOLE RESONANCE. B.Dreyfus and D.Dautreppe.
C.R. Acad. Sci.(Paris), Vol. 243, No. 20, 1517-20 (Nov. 12, 1956). In French.

The intensity of the quadrupole resonance is observed as a function of impurity concentration and in general is found to be reduced in intensity with increased second moment. For p-$C_6H_4Cl_2$ and p-$C_6H_4I_2$ in p-$C_6H_4Br_2$ each impurity molecule removes 30 and 80 host molecules respectively from the resonance; for p-$C_6H_4Br_2$ in p-$C_6H_4Cl_2$ the number is 160. D.H.Whiffen

548.7 : 539.185.9

4901. DENSITY CHANGES IN NEUTRON IRRADIATED QUARTZ. P.G.Klemens.
Phil. Mag. (Eighth Ser.), Vol. 1, 938-41 (Oct., 1956).

A new mechanism is proposed to explain the initial increase in the rate of density change observed after irradiation (Abstr. 2826/1953, Abstr. 6022/1954). Small vitreous inclusions formed inside the crystal are unable to expand completely because of the constraint due to the surrounding crystalline material. When an appreciable fraction of the volume has been vitrified, the shear stresses at some points will be large enough to start plastic flow, and full expansion, which was previously restricted by the undamaged material, will take place. J.Adam

548.7 : 534.321.9

4902. DETECTION OF DIRECTIONAL NEUTRON DAMAGE IN SILICON BY MEANS OF ULTRASONIC DOUBLE REFRACTION MEASUREMENTS. R.Truell, L.J.Teutonico and P.W.Levy.
Phys. Rev., Vol. 105, No. 6, 1723-9 (March 15, 1957).

The presence of oriented regions of displaced atoms (directional radiation damage) produced by a beam of approximately collimated fission neutrons in silicon single crystals has been observed by an ultrasonic double refraction method. The effects observed are anisotropic velocity or modulus changes which do not appear to be accompanied by attenuation changes. The irradiated crystal shows a very pronounced ultrasonic double refraction effect with waves propagated at right angles to the bombardment direction together with the absence of such a double refraction effect when the waves are propagated in the direction of the bombarding neutrons. Separate, independent, ultrasonic velocity measurements indicate that the irradiation has lowered the velocities perpendicular to the bombardment direction in a manner entirely consistent with the double refraction measurements. The observed velocity effects are not accompanied by detectable attenuation changes and are therefore not connected with dislocation damping phenomena. A.

548.7

4903. STACKING FAULTS IN COLD-WORKED COBALT–NICKEL ALLOYS. J.W.Christian and J.Spreadborough.
Phil. Mag. (Eighth Ser.), Vol. 1, 1069-75 (Nov., 1956).

Reports X-ray determinations of the density of stacking faults in cold-worked alloys containing 50-69 weight % of cobalt. A rapid rise in this density at compositions close to the limit of face-centred cubic structure is correlated with a corresponding increase in electrical resistance. All faults can be removed by annealing at 500°C for 30 min. It is therefore suggested that the faults may best be regarded as extended dislocations. A.B.Lidiard

548.7 : 537.312.6

4904. QUENCHING VACANCIES IN GOLD. F.J.Bradshaw and S.Pearson.
Phil. Mag.(Eighth Ser.), Vol. 2, 379-83 (March, 1957).

Increases in the electrical resistivity of gold wires due to quenching have been measured and interpreted in terms of vacancies. The energy for vacancy formation was deduced to be 0.95 eV and the concentration of vacancies at the melting point 6×10^{-4}. Annealing measurements between 70° and 130° C indicated that the movement energy of a vacancy was 0.68 eV and that it had on average a life of 10^8–10^9 jumps. A.

548.7 : 535.323

THE REFRACTION OF LIGHT IN CRYSTALS AND THE ENERGY OF THE BONDS BETWEEN IONS. See Abstr. 4121

548.7 : 535.37

LUMINESCENCE OF COLOUR CENTRES IN CsI–Tl CRYSTALS. See Abstr. 4164

548.7 : 535.37

LUMINESCENCE OF DECORATED DISLOCATIONS. See Abstr. 4171

548.7 : 537.312.9

THE EFFECT OF PRIOR EXTENSION ON THE ANNEALING RATE OF LATTICE VACANCIES IN PLATINUM. See Abstr. 4383

548.7 : 538.615 : 535.337

THE DIAMAGNETISM OF THE EXCITON OF A CRYSTAL OF CUPROUS OXIDE. See Abstr. 4135

548.7 : 539.172.4

RELATIONS BETWEEN THE SCATTERING OF NEUTRONS IN POLYCRYSTALS AND SPECIFIC HEAT. See Abstr. 4739

548.7 : 539.217

EFFECT OF STRUCTURAL DEFECTS IN GERMANIUM ON THE DIFFUSION AND ACCEPTOR BEHAVIOUR OF COPPER. See Abstr. 4797

548.7 : 539.4.016

WORK-HARDENING AND WORK-SOFTENING OF FACE-CENTRED CUBIC METAL CRYSTALS. See Abstr. 4817

548.736.3 : 538.221

4905. CRYSTAL STRUCTURE OF FERROMAGNETIC NICKEL OXIDE. Y.Shimomura, M.Kojima and S.Saito.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1136-46 (Nov., 1956).

The determination of crystal structure was performed on the ferromagnetic nickel oxide obtained by the flame fusion method. Apart from a slight deviation of axial angle from 90°, it has a defect tetragonal structure belonging to the space group $I4_1/amd$ (D_{4h}^{19}), the lattice constants being $a = 5.899_6$ kX and $c = 8.343_4$ ($c/a = \sqrt{2}$) at 31.5°C. Considering the deviation, the structure must be altered to a monoclinic one belonging to $C2/m$ (C_{2h}^3), the lattice constants being $a = 5.104_4$ kX, $b = 2.951_5$ kX and $\beta = 125^\circ 11.4'$ at the same temperature as above. The details of the atomic arrangements in both cases are given. The saturation magnetization estimated under an appropriate assumption for the spin alignment agrees fairly well with the observation. Thus the comparison of the present structure with that of the ordinary nickel oxide may elucidate one of the processes of transition from an antiferromagnetic state to a ferromagnetic one. A.

548.736.4

4906. ON STABILITY OF CRYSTAL STRUCTURE IN SYSTEMS OF SOLID SOLUTIONS Hg Se–Hg Te. O.D.Elpat'evskaya, R.A.Konikova, A.R.Regel' and I.V.Yavorskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 10, 2154-6 (1956). In Russian.

Specimens of HgSe, HgTe and intermediate solid solutions were prepared by pouring, by simple mechanical mixing and by thermal distillation in vacuum. X-ray photographs were taken of the products, and their electrical properties investigated. It was established that HgSe sublimes at 500°C without appreciable dissociation, whereas with Hg Te, the lattice parameter is appreciably altered by distillation at 320°C. R.F.S.Hearmon

548.736.4 : 548.52 : 537.226.2

4907. SINGLE CRYSTALS OF STRONTIUM TITANATE. A.L.Khodakov, M.L.Sholokhovich, E.G.Fesenko and O.P.Kramarov.
Zh. tekh. Fiz., Vol. 26, No. 11, 2506-7 (1956). In Russian.

Single crystals of $SrTiO_3$ were crystallized from a solution in KF in an open Pt dish and were transparent yellow cubes with edges about 1 mm. The perovskite structure was checked by X-ray diffraction, and chemical analysis gave 46.7% Sr and 25.9% Ti. Crystals with forms {100} and {111} were produced from a solution of $SrTiO_3$ in 60% mol. Na_2CO_3, 40% mol. K_2CO_3 but these contained 0.7% Fe. The dielectric constants of the two samples were significantly different, for the first being about 150 and for the second 340 at room temperature. A.L.Mackay

548.73

4908. RELATIVE MAGNITUDE OF CRYSTALLINE FIELDS; CRYSTAL STRUCTURE OF METHYL IODIDE. R.M.Hexter.
J. chem. Phys., Vol. 25, No. 6, 1286 (Dec., 1956).

Mador and Quinn's interpretation of the infrared spectra of polycrystalline CH_3I (Abstr. 1510/1953) conforms to the crystal structure recently reported for CH_3Cl. Splittings of 7-23 cm^{-1} of the degenerate fundamentals in the infrared spectrum are probably due to a crystal-field effect. G.Allen

548.74 : 538.221 : 621.318.13

4909. NEUTRON-DIFFRACTION STUDIES OF THE MANGANESE–MAGNESIUM FERRITE SYSTEM. R.Nathans, S.J.Pickart, S.E.Harrison and C.J.Kriessman.
Proc. Instn Elect. Engrs, Paper 2182R, publ. Oct., 1956 (Part B Suppl. No. 5, 216-19, 228-30).

Republication, with discussion, of the paper abstracted in Abstr. 8492 (1956).

GEOPHYSICS 55

550.381

4910. RECENT IMPROVEMENTS IN GEOMAGNETIC MEASUREMENTS. E.Thellier.
J. Phys. Radium, Vol. 18, No. 1, 9-10 (Jan., 1957). In French.

Two possibilities have recently been developed in the technique of geomagnetic measurement: first, the absolute determination of the total intensity of the field using nuclear proton resonance, and secondly, airborne determination of intensity and direction of field. A.

ATMOSPHERE. METEOROLOGY 551.5

551.508.5 : 533.6.08

A LINEAR, TEMPERATURE COMPENSATED HOT-WIRE ANEMOMETER. See Abstr. 4033

551.510.535 : 538.566.3

4911. IONOSPHERIC REFLECTIONS FROM HEIGHTS BELOW THE E REGION. J.B.Gregory.
Austral. J. Phys., Vol. 9, No. 3, 324-42 (Sept., 1956).

The pulse method of radio sounding has been used at 1.75 Mc/s to detect low ionospheric regions whose voltage reflection coefficient exceeds 4×10^{-6}. Observations from February to July 1955 have revealed reflections, from 95 km vertical height and of day-time occurrence only, which are believed to originate in the lower E-region. A region with a lower boundary predominatly at 85 km has been found to exist continuously, and previous suggestions as to its meteor origin are queried. A series of complex partial reflections have been detected during day-time only down to 53 km, with significant heights near 75, 67, and 55 km. The occurrence and strength of these lower reflections increases markedly during winter. From records of high absorption conditions during winter days, a connection between the decrease in strength of E-region reflections and the increase in strength of partial reflections between 66 and 88 km approximately is demonstrated. A.

551.510.535

4912. CUSP TYPE ANOMALIES IN VARIABLE FREQUENCY IONOSPHERIC RECORDS. G.H.Munro and L.H.Heisler.
Austral. J. Phys., Vol. 9, No. 3, 343-58 (Sept., 1956).

Anomalous cusps which frequently appear at the high frequency end of ionosonde records of the F_2-region are explained as the result of modification of the ion distribution during the passage of typical travelling disturbances. They indicate the presence, not of vertical stratification but of horizontal gradients of ionization causing oblique reflection. It is suggested that other anomalous cusps are of similar origin. Anomalies on records of the F_1-region are also shown to be caused by travelling disturbances. It is demonstrated that these explanations provide useful guidance in the interpretation of ionospheric records and facilitate the further study of travelling disturbances. A.

551.510.535

4913. DIVERGENCE OF RADIO RAYS IN THE IONOSPHERE. G.H.Munro and L.H.Heisler.
Austral. J. Phys., Vol. 9, No. 3, 359-72 (Sept., 1956).

Travelling disturbance manifestations on ionosonde records usually occur at different times on the "o" and "x" traces. It is shown that this is due to the divergence of the ordinary and the extraordinary rays in the earth's magnetic meridian plane and that the sense of this time difference, therefore, gives a direct indication of the sense of the north-south component of movement of the disturbance. Furthermore, where the direction and speed of travel of a disturbance can also be determined from spaced station observations, the actual separation of reflection points of the o- and the x-rays can be deduced. At Sydney, N.S.W. (33° 52' S., 151° 11' E.) this is of the order of 30 km at the height of maximum ionization of the F_2-region. On h't records the corresponding time difference observed includes a component due to the vertical separation of reflection points if the front of the disturbance is not vertical. From records of this type taken at three spaced stations the horizontal component may be determined directly. Examination of some 430 such observations taken over a period of 4 years confirms the variation of the time difference with direction of travel predicted by theory, and also indicates the consistent presence of a forward tilt in the front of disturbances. The theoretical relation between the horizontal and vertical separation is then used to determine the slope of front of disturbances. It is found to have a mean value varying from 65° to the horizontal for disturbances travelling northward to a minimum of 51° for those travelling 120° E. of N. A.

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.510.535 : 551.515.4

4914. THUNDERSTORMS AND SPORADIC E LAYER IONISATION. R.G.Rastogi.
Indian J. Meteorol. Geophys., Vol. 8, No. 1, 43-54 (Jan., 1957).

The paper describes the results of vertical P'–f recordings of ionospheric reflections carried out during the passage of thunderstorms over Ahmedabad. The thunderstorms were found to be accompanied by an increase in sporadic E-ionization as shown by a rise in the maximum frequency of Es or an increase in the intensity of reflection from Es. A.

551.515.11 : 532.517.4

FLUCTUATIONS IN THE TROPOSPHERE AND IONOSPHERE. See Abstr. 4005

551.521.1 : 537.312.5

PHOTOELECTRIC CONVERTORS OF SOLAR ENERGY MADE FROM P-TYPE SILICON. See Abstr. 4372

551.543

4915. STATISTICAL ANALYSIS OF AUSTRALIAN PRESSURE DATA. S.C.Das.
Austral. J. Phys., Vol. 9, No. 3, 394-9 (Sept., 1956).

Analysis of the pressure data along the east coast of Australia, to test a hypothesis which arose out of Deacon's (Abstr. 6331/1953) work, that there was a shift in the mean high-pressure belt. It is shown that the belt is slowly moving southward. A.

551.593.12

4916. STELLAR SCINTILLATION. P.B.Fellgett; E.C.S.Megaw; J.van Isacker.
Quart. J. Roy. Meteorol. Soc., Vol. 82, 227-31, 231-2, 232-3, 233-4 (April, 1956).

In correspondence arising from the published report of a discussion on "stellar scintillation" held in London, on 16th December, 1953, Fellgett asserts that the validity of ray-theory is subject to a condition which does not allow of its application to the problem under discussion. In reply, Megaw and van Isacker both agree that Fellgett has failed to establish a case against the use of geometric optics. They contend that both ray, and wave theories may be correctly used in those aspects of the scintillation problem to which they are inherently suited. D.R.Barber

551.594.14

4917. METEOROLOGICAL ASPECTS OF ATOMIC RADIATION.
Science, Vol. 124, 105-12 (July 20, 1956).

Summary report, with minor changes of text, of the Committee on Meteorological Aspects of the Effects of Atomic Radiation. The removal of radioactive debris from the atmosphere is considered in three phases (1) early or "close-in" fallout within 10 to 20 hours, (2) intermediate fallout during the first weeks, and (3) delayed fallout continuing for months or even years after the explosion. The principal mechanisms for removal are gravitational settling, scavenging of radioactive particles by falling precipitation and deposition by diffusion caused by turbulent eddies in the atmosphere and these act successively in the three phases of the fallout. The methods of measurement in each phase are detailed and the factors to be considered in making estimates. The importance of an analysis of stratospheric storage from radiostrontium fallout data is emphasized. The possible hazards of atmospheric contamination due to the civilian use of nuclear energy in its many industrial and other applications is examined. Some uses of radioactive materials in atmospheric studies are discussed. It is suggested that although no definite connection between atomic explosions and subsequent

weather has been proved and is considered unlikely, yet careful physical analysis of the effects of nuclear explosions on the atmosphere must be made. R.S.Read

551.594.14 : 537.591.8

S^{35} PRODUCED BY COSMIC RAYS IN ATMOSPHERIC ARGON. See Abstr. 4519

551.594.18 : 539.164.1

4918. ALPHA-TRACKS IN NUCLEAR EMULSIONS EXPOSED TO AIR WITH HIGH RADON CONTENT. G.Aliverti, A.De Maio, G.Lovera and R.Perilli-Fedeli.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1580-2 (Dec., 1956). In Italian.

With the aim of obtaining information on α-tracks due to natural radioactivity present in the atmosphere, two plates were introduced in a closed volume of air in contact with water from radioactive springs. Results on the number and length of tracks agree with those of Deutsch (Abstr. 6103/1956), but the present authors observed about 2% of double tracks (RaA, RaC'). L.Pincherle

BIOLOGY 57/59

578.087.9

4919. VARIABLE RESISTANCE BICYCLE ERGOMETER FOR PERFORMANCE OF RECUMBENT EXERCISE. S.M.Sancetta and R.J.Carleton, Jr.
Rev. sci. Instrum., Vol. 28, No. 2, 125-6 (Feb., 1957).

The construction and performance details of a simple and economical bicycle ergometer for performance of controlled recumbent exercise incident to human physiological experiments are reported. Bicycle sprockets are geared by a chain drive to the shaft of a 6 volt automotive generator, which has been transformed into an eddy current dynamometer, suitably mounted on the chassis via separate external bearings. This permits free forward rotation of the external casing and measurement of the downward thrust of a torque arm (welded to the casing) on an overhead-suspended spring balance. Absorbed power (work required to operate the pedals) is varied electrically by passing a 110 V a.c. power source through variable voltage and stepdown transformers (output range selection 0 to 20 V) and a rectifier into the generator. At rotational speeds of 40 r.p.m. (metronome timed) the work range may be selected from 340 to 5741 ft-lb per min, with increments as low as 42 ft-lb. The apparatus provides 95% linearity through the 360^0 cycle at rotational speeds of 30 to 60 r.p.m. in a work range of 340 to 5100 ft-lb per min. A.

578.088.2

4920. ON BRAIN LESIONS FROM FOCUSED ULTRASOUND. H.T.Ballantine, Jr, W.C.Cotter and T.F.Hueter.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1292-3 (Nov., 1956).

Answer of criticisms by W.J.Fry (Abstr. 7907/1956) of the paper by Hueter et al. (Abstr. 4125/1956).

578.088.2 : 539.374

4921. PRELIMINARY MEASUREMENTS ON THE VISCOELASTIC PROPERTIES OF ANIMAL TISSUES AT AUDIO-FREQUENCIES. E.R.Fitzgerald, E.Ackerman and J.W.Fitzgerald.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 61-4 (Jan., 1957).

In this preliminary investigation the electromagnetic transducer method of Fitzgerald and Ferry is used to obtain the complex shear compliance and shear modulus of muscle tissue taken from a freshly killed cow at room temperatures and in a frequency range from 25 to 2500 c/s. Both the level and the shape of the compliance–frequency curves are found to depend on the elapsed time after slaughtering. While there are some difficulties due to the rapid changes in viscoelastic properties with time, the results indicate that the method can be successfully applied to determine the viscoelastic properties of animal tissues. A.

578.088.2

4922. RESPONSE OF THE SKIN TO FOCUSED ULTRASOUND. E.Bell and T.S.Argyris.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 239-42 (Feb., 1957).

Skin of mice has been irradiated with focused ultrasound of 1 Mc/s frequency. Skin in the growing phase of the hair growth cycle becomes ulcerated within two days following treatment while skin in the resting phase of the cycle is relatively unaffected. It is concluded that the response of the skin to ultrasound depends upon the physiological state of the organ at the time of irradiation. Thermal changes which occur during irradiation with ultrasound were measured in resting and growing skin, and no significant difference in absorption of acoustic energy between the systems was found. Since the capacities of the respective systems for absorbing ultrasound are equal this factor can be eliminated as a possible cause for the differential response of the skin. It is also suggested that the differential response of the skin cannot be attributed to structural differences between resting and growing follicles. When skin is irradiated with focused light which produces the same thermal change as that produced by ultrasound, skin in growth is ulcerated and skin at rest is unaffected. The heating component of ultrasound appears to be the physical factor to which the biological response can be attributed. A.

591.185.5

4923. PHYSIOLOGICAL EVIDENCE FOR THE MASKING OF LOW FREQUENCIES BY HIGH. B.H.Deatherage, H.Davis and D.H.Eldredge.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 132-7 (Jan., 1957).

Observations were made on guinea pig with intracochlear electrodes. Successive waves of low-frequency stimulation set off well-synchronized volleys of action potentials (AP) as well as the familiar cochlear microphonic (CM). The phenomenon of masking of a 500 c/s tone pip is, of course, observed when a low-frequency band of noise, centred on 500 c/s, obscures the CM and masks the AP that result from the pip. At comparable levels of stimulation, a high-frequency band of noise centred on 6950 c/s and having no appreciable energy in the 500 c/s region will not mask. But, as the intensity of the high-frequency sound is raised to high levels, masking occurs. A random, low-frequency CM now appears in the apical region in addition to the expected high-frequency CM response in the basal turn. It is inferred that the ear responds nonlinearly to the high-level noise and "detects" its envelope as random low frequencies of random amplitude. This anomalous masking is produced both by a band of noise and by a high-frequency tone which is amplitude modulated by a low frequency. A.

591.185.5

4924. ELECTROPHYSIOLOGICAL EVIDENCE FOR AUDITORY SENSITIZATION. J.R.Hughes and W.A.Rosenblith.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 275-80 (Feb., 1957).

This study was designed to investigate the properties of the first neural response (N_1) to tone pips; the responses were recorded from the round window of the cat. Amplitude, latency, and adaptation (equilibration) curves were studied. The major part of the investigation was concerned with the effect of low-tone exposure on the amplitude of the N_1 response to tone pips. After a relatively intense exposure, the amplitude of the N_1 response, compared with the pre-exposure level, shows an initial subnormality (decreased response), a sensitization (increased response), and then a second subnormality. Sensitization was found when the exposure tone was the same, higher and lower in frequency than the basic frequency of the test tone pip. Exposure to low-frequency noise gives rise to a monotonic recovery process, i.e. a subnormality without subsequent sensitization. Contralateral effects were not detected. This sensitization of the N_1 response is compared with related psychophysical data and may be regarded as an example of post-tetatnic potentiation. Psychophysical experiments have demonstrated the existence of "auditory sensitization" (a lowering of the absolute threshold for pure tones after low-tone exposure). After a relatively intense exposure, there is a brief rise in threshold, then a sensitization which lasts for approximately 2 min, followed by a long-lasting second rise in threshold. This psychophysical study also demonstrated that a relatively wide range of exposure frequencies can sensitize the auditory system to a given test tone pip. In order to obtain comparable evidence for sensitization in the electrical activity of the auditory nervous system, electrophysiological experiments were conducted on cats. The present study was designed to investigate the effect of a pure-tone stimulus on the properties of the first neural response (N_1) recorde

from the vicinity of the round window of the cat's cochlea. The major part of the investigation was concerned with whether, after low-tone exposure, the N_1 response exceeds in amplitude the pre-exposure value: this phenomenon is called "sensitization of N_1". These electrophysiological studies on sensitization may be related to post-tetanic potentiation (PTP); this possible relationship will be discussed later. PTP refers to the increased responsiveness of the nervous system after application of a tetanizing stimulus. A.

MEDICAL SCIENCE. HUMAN PHYSIOLOGY

61

612.17 : 534.8

4925. ACOUSTIC MAPPING WITHIN THE HEART. J.D.Wallace, J.R.Brown, Jr, D.H.Lewis and G.W.Deitz.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 9-15 (Jan., 1957).

A cylindrical barium titanate element has been placed at the distal end of a specially designed catheter and used in studies of the heart sounds of dogs and humans. Heart sounds have been recorded with the element located in the four chambers of the heart as well as in the great vessels leading from the heart. X-ray photographs monitored the location of the catheter tip in each case. The sounds have been recorded on tape and simultaneously on a photographic galvanometer recorder, all studies were continuously monitored by electrocardiogram. Sound spectrographic analysis of the several sounds was made and analysed. A.

612.84

4926. ELECTRO-MECHANICAL MODEL OF THE HUMAN VISUAL SYSTEM. J.R.Singer.
J. Opt. Soc. Amer., Vol. 47, No. 3, 205-7 (March, 1957).

A servomechanism is described which simulates the eye response in directing visual receptors. Feedback to provide corrective directing is based upon matching the images conducted to the "brain" by the neurons. The model uses photoelectric cells to receive the images. The image from each receptor unit (eye) is separated into two parts. The images are reproduced in the "brain" by illuminating light bulbs corresponding to the photoelectric cell receptors. A photoelectric scanner in the "brain" determines the amount of agreement of the images depicted by the several banks of light bulbs. Feedback leading to corrective directing (fusion) is produced by voltages generated in the scanner bridge circuit and causes a motor to oscillate the "eyeball" until images from both eyes are matched. Brain damage would cause continual oscillation of the eyeball and lead to the peculiar patterns drawn by some head-injured people. A.

612.841 : 778.3

4927. NEW PHOTOKERATOSCOPE UTILIZING A HEMISPHERICAL OBJECT SURFACE. H.A.Knoll, R.Stimson and C.L.Weeks.
J. Opt. Soc. Amer., Vol. 47, No. 3, 221-2 (March, 1957).

A photokeratoscope is described which makes it possible to record in a single photographic exposure the contour of the entire corneal surface of the eye. This has been accomplished by using a hemispherical object surface located such that its centre of curvature coincides with the centre of curvature of the cornea being photographed. The reflection of this surface is photographed through a small hole in the object surface. A brief history of the development of photokeratoscopy is presented. Photographs taken thus far verify the spherical nature of the central zone of the cornea. A.

612.843.2 : 537.531

4928. ON THE VISIBILITY OF X-RAYS. M.Tagüeña.
Ciencia (Mexico), Vol. 16, No. 4-6, 76-8 (1956). In Spanish.

The literature dealing with visual sensations due to X-rays is reviewed. New experiments were done with lead figures after 15 min dark-adaptation. The visual sensation increased in intensity with the dosage. The nature of the sensation is discussed. R.A.Weale

612.843.2

4929. RESPONSE OF THE HUMAN EYE TO SUDDEN CHANGES IN THE WAVELENGTH OF STIMULATION. W.R.Biersdorf and J.C.Armington.
J. Opt. Soc. Amer., Vol. 47, No. 3, 208-15 (March, 1957).

The human electroretinogram (E.R.G.) was elicited by an abrupt replacement of a chromatic adaptation stimulus with a long duration test stimulus. It was found that the relative spectral sensitivity of the E.R.G. was strongly dependent upon the colour and luminance of the adaptation stimulus with adaptation to a particular colour lowering sensitivity to the same part of the spectrum. Clear-cut responses were produced by test luminances below an adaptation luminance only when the two were far part in the spectrum. Analysis of the data gave definite evidence for two spectral processes with maximum near 500 and 620 mμ. There was evidence for other possible processes in the green and blue but their maxima were not well defined. A.

612.843.2

4930. NOTE ON A FUNCTION OF STIMULUS ORIENTATION COMMON TO SEVERAL ASPECTS OF VISION. M.Lichtenstein.
J. Opt. Soc. Amer., Vol. 47, No. 3, 256-7 (March, 1957).

Attention is drawn to the fact that a number of recent investigators found certain radially variable visual functions to be optimal at 0, 90, 180 and 270°. R.A.Weale

612.843.32

4931. RE-EVALUATION OF BOYNTON'S SENSITIVITY DATA. H.von Schelling.
J. Opt. Soc. Amer., Vol. 47, No. 1, 106-7 (Jan., 1957).

Boynton's data (Abstr. 3403/1956) for the spectral sensitivity of the fovea in the presence of chromatic adapting stimuli are shown to be functions of only three variables. R.A.Weale

612.843.37

4932. CALCULATED EFFECT OF THE COLOR TEMPERATURE OF THE STIMULUS ON SCOTOPIC THRESHOLDS. J.A.S.Kinney.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1093-4 (Dec., 1956).

Data have been calculated which make it possible to refer scotopic luminance values obtained with sources of colour temperatures ranging from 2042 to 6486°K to luminance values obtained with a standard 2042° K source. R.A.Weale

612.843.611

4933. ON RESPONSES IN THE HUMAN VISUAL SYSTEM AS A FUNCTION OF ADAPTATION LEVEL. R.M.Boynton and G.Kandel.
J. Opt. Soc. Amer., Vol. 47, No. 4, 275-86 (April, 1957).

Thresholds are determined at various short times before and after the onset of a 38 mL conditioning stimulus in the dark-adapted eye, and following six other levels of pre-adaptation. An outstanding feature of the results is that under certain conditions thresholds decrease with increasing pre-adapting luminance. The results are considered to provide an indirect picture of on-responses in the visual system. The relation between "masking" associated with these on-responses and those effects attributable to photochemical bleaching is assessed and discussed. A.

612.843.611

4934. CHANGING PRE-EXPOSURE AND DARK ADAPTATION. F.A.Mote and L.M.Forbes.
J. Opt. Soc. Amer., Vol. 47, No. 4, 287-90 (April, 1957).

The dark adaptation of two subjects was measured following pre-exposures that changed from zero to maximum intensity and the reverse, from maximum to zero, as well as for equivalent unchanging pre-exposures. Three intensities and four durations of pre-exposure were investigated. The main effects found were between the two changing conditions: for most of these the zero to maximum intensity resulted in higher initial thresholds and longer times to reach the final dark-adapted threshold than the equivalent condition in which the pre-exposure was from maximum to zero. A.

612.843.721

4935. SUPPRESSION OF MULTIPLE IMAGES IN LIPPMANN'S INTEGRAL METHOD OF STEREOSCOPY. A.C.Traub.
J. Opt. Soc. Amer., Vol. 47, No. 1, 104-5 (Jan., 1957).

Estanave's pin-hole modification of Lippmann's method for making free vision stereoscopic photographs suffers from several defects. One of them - concerning the periodic repetition of the image over the surface of the stereogram - can be remedied by making exposures one at a time in two or more separate planes. R.A.Weale

612.85

4936. CONSTANT-LOUDNESS CURVES FOR SUSTAINED NOTES AND FOR SINGLE PRESSURE PULSES. R.Feldtkeller.
Frequenz, Vol. 10, No. 11, 356-8 (Nov., 1956). In German.

With a duration of less than 200 msec, a constant-frequency note can no longer be recognized as a specific tone and its loudness cannot be satisfactorily compared with a sustained 1 kc/s note. A

basis for comparison is achieved by repeating half-cycle impulses at varying repetition frequencies and comparing the resulting sound with a normal 1 kc/s tone. Constant loudness curves are derived from the results for impulses ranging in length from 0.05 to 1.0 msec and in loudness from the threshold of hearing to 70 phon. Apparent loudness is independent of pulse length below 0.15 msec: with increasing pulse length the apparent loudness curves rise to coincide with the corresponding normal curves at the very-low-frequency end. White noise and random pulses are similarly compared with sustained tones. H.G.M.Spratt

612.85

4937. EFFECT OF VISUAL FACTORS ON THE INTELLIGIBILITY OF SPEECH. K.K.Neely.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1275-7 (Nov., 1956).

Research has indicated the important role that vision plays in face-to-face voice communication. This study was an attempt to quantify further the visual contribution of speech intelligibility in a high-intensity noise environment in terms of the angle and distance from the listener to the speaker. Results indicated that (1) visual cues resulted in a significant increase in listener-intelligibility scores, (2) the angle at which the listeners observed the speaker influenced their listener-intelligibility scores, and (3) the distance of the listener from the speaker did not have a significant effect on listener-intelligibility scores within three to nine foot limits. The importance of speech-reading training and the use of visual cues is evident where face-to-face voice communication has to be conducted in high noise environment. A.

612.85

4938. SOME RESULTS OF RESEARCH ON SPEECH PERCEPTION. A.M.Liberman.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 117-23 (Jan., 1957).

Recent experiments with synthetic speech have succeeded in isolating some of the acoustic cues which underlie the perception of speech. This paper describes, and attempts to interpret, some of the research in that area. A.

612.85

4939. CONCERNING NEW METHODS OF THE MEASUREMENT OF HEARING IN MAN. G.V.Gersuni.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 129-31 (Jan., 1957).

It is known that the main quantitative characteristics of hearing in man can be obtained by so-called psychophysical methods. In these methods the responses to sound stimuli are based upon the use of verbal instructions. This paper gives a description of methods of measurements of hearing based upon the use of other different responses to sound stimuli. A set of different conditioned responses was used (galvanic-skin reflexes, eyelid reflexes, electrocortical and oculomotor reactions). The data obtained by these methods show the following: (1) absolute auditory thresholds and difference limens for frequency and intensity of pure tones can be measured with the same accuracy by these reactions as by verbal responses; (2) in certain cases conditioned reflexes subliminal to the verbal response in the range of 1 to 6 dB may be detected; (3) changes of absolute sensitivity, attaining 25 to 30 dB and dependent on the conditions under which the reactions take place, can be detected. The present data of hearing measurements obtained by means of different responses are considered as highly characteristic of the process of sound discrimination in man and animals. A.

612.85

4940. ABSOLUTE JUDGMENTS OF MUSICAL TONALITY. J.F.Corso.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 138-44 (Jan., 1957).

The purpose of the present study was to determine the accuracy with which college musicians could make absolute judgments of equally-tempered tonalities. The stimuli consisted of three randomly-ordered presentations of twelve major and twelve minor keys within each of three series of tape-recorded piano tones. Series I consisted of eight-tone ascending diatonic scales; series II, the eight tones of the diatonic scales randomized for each key; and series III, sequences of four chords. The results of the study indicate that judgments of the twenty-four specific keys are most often correct for the ascending scales and least often correct for the randomized "scales". The identification of major and minor modes is, on the average, not perfect, but is increased when the subjects are instructed to judge only modes, disregarding key-names. In general, major keys are more often correctly identified than minor keys. It is suggested that judgments of musical tonality are probably multidimensional and influenced by set. A.

612.85

4941. THRESHOLD FOR THERMAL NOISE AS A FUNCTION OF DURATION AND INTERRUPTION RATE. W.R.Thurlow and R.Bowman.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 281-3 (Feb., 1957).

Experiments are reported on temporal summation at hearing threshold for thermal noise. Durations from 1 to 850 msec and repetition rates from 1 to 100 per sec were used. Results show that threshold decreases as a function of duration for all repetition rates. Thresholds also decrease as a function of repetition rate, though the effect of repetition rate is not so marked as that of duration, and becomes even less so at long durations. A.

612.85

4942. ON THE RELATION BETWEEN THE INTELLIGIBILITY AND FREQUENCY OF OCCURRENCE OF ENGLISH WORDS. D.Howes.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 296-305 (Feb., 1957).

The threshold of intelligibility for a word in a wide-spectrum noise is shown to be a decreasing function of the frequency with which the word occurs in general linguistic usage (word frequency). The drop in threshold is about 4.5 dB per logarithmic unit of word frequency. This rate is independent of the length of the word, although the thresholds for words of given frequency of occurrence are lower for long words. The effect of restricting the listener's alternatives in an intelligibility test to a specified number of words is calculated from this relationship. These calculations come within 1 dB of published experimental data. Theoretical functions relating intelligibility threshold to word length are also calculated from the word-frequency effect, on the assumption that listeners can discriminate the length of a word at levels too low for it to be identified. These functions are in general agreement with the experimental results. Implications for intelligibility testing procedures are discussed. A.

612.85

4943. MASKING OF SPEECH BY LINE-SPECTRUM INTERFERENCE. J.C.R.Licklider and N.Guttman.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 287-96 (Feb., 1957).

Two series of intelligibility tests were conducted. In the tests, speech was presented against a background of interference. The line-spectrum interference consisted of from 4 to 256 sinusoids, superposed in a linear adder. Three different spacings of the components in frequency, and several different distributions of power among the components, were studied. Tests with continuous spectrum random noise were made for comparison. The over-all interference power required to reduce intelligibility to a given level decreases as the number of components in the interference increase. The drop is about 10 dB in the decade from 4 to 40 components. Beyond 40, there is much less change. Even 256 components, however, mask measurably less effectively than random noise of equivalent power in the band 200-6100 c/s. For a given number of components, the line-spectrum interference most detrimental to intelligibility has the same number of components in each frequency band of equal contribution to intellibigility, and its components are uniform in amplitude. The bearing of these findings on the theory of intelligibility and on procedures for predicting intelligibility from physical parameters is discussed. A.

612.858.4

4944. OVERSTIMULATION, FATIGUE, AND ONSET OF OVERLOAD IN THE NORMAL HUMAN EAR. M.Lawrence and P.A.Yantis.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 265-74 (Feb., 1957).

Studies on the effect of overstimulation upon the ear have been handicapped by lack of an audiometric procedure known to detect subtle changes in the organ of Corti. Fatigue has often been suggested and used but studies of the cochlear potentials associated with low-intensity vibration of the organ of Corti have never revealed such fatigue, which must arise from more central structures. Fatigue following high levels of sound intensity is probably a sum of "neural" fatigue and an injury to the organ of Corti. On the other hand, such studies have shown aural overload to result from an overdriving of the organ of Corti beginning at an intensity of sound considerably below that which is injurious. The experiments reported here compare the shift in audibility threshold and in onset of overload following one-minute stimulations with a 1000 c/s tone at sensation levels of 20, 60, 80, 90, 100 and 110 dB. The amount of post-stimulus fatigue measured 6 seconds after cessation of the fatiguing tone showed little variation with intensity of fatiguing tone whereas the onset of overload, when compensation was made for fatigue of the harmonic frequency, showed a progressive lowering with increase of intensity of fatigue tone. It is concluded that with-

in the limitations of these experimental conditions the fatigue measured is not a property of the sensory cells whose sensitivity does not change until an injurious level of tone is reached, but that overloading is a property of these cells and the lowering of its onset level reflects an increasing decrement in performance following increasing intensities of stimulation. A.

612.858.751

4945. OBJECTIVE ALLOCATION OF SOUND-IMAGE FROM BINAURAL STIMULATION. Y.Kikuchi.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 124-8 (Jan., 1957).

This paper describes two methods for making an objective quantification of the location of the sound image that results from binaural acoustic stimulation. This first method ("nullity method") is based on reversing, by means of a changeover device equivalent to a double-pole, double-throw switch, the binaural signals — switching the signal from the right ear to the left ear and the signal from the left ear to the right ear. Adjustments are made in one of the two channels until this reversal does not appear to change the location of the sound-image. The second method ("comparison-sensation method") involves a pilot signal, which is applied binaurally and used to produce a reference image with which the experimental sound image is compared. These methods are more objective than the ones usually employed because they require the observer to function only as a null indicator. Data are presented which show that the "nullity method" yields data that are much less variable than those obtained with the ordinary method. A.

615.475

4946. THE MEASUREMENT OF RADIO-ACTIVITY IN THE HUMAN BODY BY NaI-Tl SCINTILLATION COUNTERS. R.B.Owen.
Atomic Energy Res. Establ.(Harwell) Rep. EL/R1851, 5 pp. (1956).

A "whole-body" γ-radiation monitor, consisting of a lead chamber with four NaI(Tl) scintillation counters mounted in the roof, has been designed and calibrated. The potassium impurity in the crystals is a major source of background. The sensitivity of the monitor, and improvements to be achieved with purer and larger crystals are discussed. J.B.Birks

615.475

4947. PRELIMINARY INVESTIGATIONS OF SCINTILLATION COUNTER TECHNIQUES FOR THE MEASUREMENT OF RADIO-ACTIVITY FROM THE HUMAN BODY. F.Wade.
Atomic Energy Res. Establ.(Harwell) Mem. EL/M92, 6 pp. (1955).

An initial study has been made of the use of NaI scintillation counters in a "whole-body" γ-radiation monitor. J.B.Birks

TECHNIQUE. MATERIALS 62/69

66.067.5

4948. THE CALIBRATION AND USE OF AN AIR-DRIVEN ULTRACENTRIFUGE. P.Johnson.
J. sci. Instrum., Vol. 34, No. 3, 91-7 (March, 1957).

The operation of a commonly available (Phywe) type of air-driven ultracentrifuge is discussed, with particular stress upon those experimental aspects which affect the accuracy of derived sedimentation constants. The use of a thermistor in a simple bridge circuit and its calibration by the melting of diphenyl ether to give the actual temperature of the ultracentrifuge cell is described. The derived correction is found to be constant over a considerable range of values of the rotational speed and of hydrogen pressure, but it is strongly dependent upon rotor-thermistor distance. There is good evidence that the thermistor keeps pace with changing rotor temperature. A considerable measure of agreement between the sedimentation constants derived on the basis of the above calibration with those obtained from Spinco values after correction for the adiabatic cooling of the rotor is shown. Attention is drawn to the use of a ball bearing in the base of the rotor which is the probable cause of the unduly large increase in rotor temperature during normal operation. A.

PHOTOGRAPHY 77

77.023.7

4949. FURTHER RESEARCH INTO THE CLEARING OF β-SENSITIVE EMULSIONS. T.Matitsch.
S.B. Österr. Akad. Wiss. IIa, Vol. 164, No. 5-7, 169-74 (1955). In German.

The clearing effects of various solutions have been investigated using Ilford G.5 plates 100 μ thick. Dilute hydrogen chloride, sodium thiosulphate, sodium chloride, bromine water and "Halazone" have all been tried at various temperatures. The effect on the sensitivity of the emulsion has also been examined. Very clear plates are obtained with hydrogen chloride solution (or NaCl) at 60° C for 1 hour with a concentration of 1 mg Cl per litre; the effect on sensitivity is very small and the distortion is also low. D.J.A.Prowse

771.4 : 537.527 : 621.327.59

4950. PROLONGED FLASHES IN XENON. E.J.G.Beeson.
BT-H Activ., Vol. 27, No. 4, 131-6 (July-Aug., 1956).

Describes the characteristics of 2.5 kW xenon flash-tubes designed to provide prolonged flashes for repetitive photography. Light output v. power, and other data, are provided. J.D.Craggs

771.534.55

4951. PHOTOGRAPHIC GRANULARITY AND GRAININESS. IX. TECHNIQUES AND EQUIPMENT FOR THE OBJECTIVE MEASUREMENT OF GRAININESS. L.A.Jones, G.C.Higgins, K.F.Stultz and H.F.Hoesterey.
J. Opt. Soc. Amer., Vol. 47, No. 4, 312-21 (April, 1957).

For Pt VIII, see Abstr. 4265 (1955). A photoelectric scanning instrument is described which gives granularity values in terms that can be converted into the graininess values that would be obtained by an observer viewing a magnified image of the sample under standard conditions. The procedure is to determine the critical scanning aperture that results in a signal corresponding to the threshold-gradient sensitivity of the eye for the density of the sample. The techniques for making two types of routine graininess measurements are described in detail. Class I measurements give the graininess of samples at a density of 0.8. Class II measurements give granularity numbers that indicate the relative graininess to be expected of matched prints made from the negatives. A.

771.534.55 : 535.317.25

MEASUREMENT OF RESOLUTION OF PHOTOGRAPHIC EMULSIONS. See Abstr. 4118

778.33 : 518.5

4952. SLIDE RULE FOR RADIOGRAPHIC ANALYSIS. B.Lundberg and B.L.Henke.
Rev. sci. Instrum., Vol. 27, No. 12, 1043-5 (Dec., 1956).

A simple slide rule has been developed which will permit a rapid and accurate determination of radiographic sample transmission, of absorption index, μm, and of the photographic film density corresponding to the direct X-ray beam by means of a single setting of the sliding scale. A.

778.34 : 771.535

4953. AN INVESTIGATION ON LATENT IMAGE FADING IN ILFORD G-5 EMULSIONS. G.Leide.
Ark. Fys., Vol. 11, Paper 23, 329-45 (1956).

Fading of individual proton tracks was determined in Ilford G-5 emulsions as a function of time, temperature, relative humidity, and energy loss. The measurements enclose the intervals 0-2 months, 3-30° C, 13-75% relative humidity and 3-20 keV/μ ionization loss. A photometric method was used to determine the grain density of individual tracks. The faded tracks were measured in the same emulsion as unfaded comparison tracks. The precautions and corrections needed are discussed. It has been found that the fading is constant in the interior of the emulsion. The fading effect is larger at the surface. The investigation was essentially confined to the constant effect of the interior. Provided that this effect is not too large, the apparent energy absorbed per unit length is diminished by

a constant factor independent of the original ionization. The factor depends on the storing conditions. The factor being constant, a faded track will appear as if it were due to a particle lighter than the real one, if compared with unfaded tracks. The apparent mass has been used to characterize the fading and has been given as a function of time, temperature, and relative humidity. The curves give a survey of the progress of fading under different conditions. A.

778.34

4954. IDENTIFICATION OF FAST CHARGED PARTICLES IN NUCLEAR EMULSIONS. T.Johansson and K.Kristiansson.
Ark. Fys., Vol. 11, Paper 41, 467-79 (1957).

Photometric grain density measurements have been made on tracks of singly charged particles not stopping in the emulsion. The method to identify particles by determining the grain density and the rate of change of grain density along the track has been studied. The method can be used for particle identification on gray tracks with $\beta \leq 0.65$. Systematic errors and errors from the statistical distribution of the grains in the tracks have been investigated. The method is less accurate than the scattering–grain density method, but it can be used as a complement to this method when unexpected results are obtained or when distortion makes scattering measurements unreliable. A.

778.34 : 537.534.3 : 537.533.3

4955. AN EMULSION SPECTROGRAPH — A NEW TECHNIQUE FOR THE DETERMINATION OF THE MOMENTA OF FAST CHARGED PARTICLES. I. DESIGN CONSIDERATIONS AND THEORY. II. CONSTRUCTION AND APPLICATIONS OF A NORMAL INCIDENCE STACK. A.J.Apostolakis and I.Macpherson.
Proc. Phys. Soc. A, Vol. 70, Pt 2, 146-53, 154-64 (Feb., 1957).

An account is given of a relatively simple device by which the signs and momenta of fast, charged particles can be measured accurately. The particles traverse normally a stack of thin layers of emulsion, separated by large gaps, in a magnetic field. Particle trajectories are reconstructed after the emulsions are developed. Consideration is given in Pt I of the paper to the requirements that a stack must satisfy in order to give a maximum detectable momentum of 300 GeV/c. In Pt II the construction of an actual stack is described and an account is given of some applications. A.

778.34 : 535.89

DARK-FIELD MICROSCOPIC ILLUMINATION FOR ENERGY MEASUREMENTS OF FAST NEUTRONS WITH PHOTOGRAPHIC EMULSIONS. See Abstr. 4264

778.34

4956. ERRORS IN CONSTANT-SAGITTA SCATTERING MEASUREMENTS IN NUCLEAR EMULSIONS. A.J.Herz, R.M.May and N.Solnsteff.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1623-5 (Dec., 1956).

In recent work on K^--particle tracks, the distribution of the scattering parameters determined from constant-sagitta scattering measurements was wider than that predicted by D'Espagnat. Further detailed measurements on one track by a number of observers have confirmed this general trend but it is thought that the additional errors are mainly due to faulty elimination of large-angle scatters, which are improved by use of the replacement technique, and to other effects which are personal and microscope-dependent. When non-random effects are unimportant, the Molière theory is substantially correct. D.J.A.Prowse

778.34

4957. CHARGE AND MOMENTUM ANALYSIS OF RELATIVISTIC PARTICLES BY THE NUCLEAR EMULSION TECHNIQUE IN PULSED MAGNETIC FIELDS. V.M.Likhachev and Yu.P.Merekov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 31-8 (1957). In Russian.

The feasibility of application of strong magnetic fields (1.2×10^5 G) in conjunction with nuclear photographic emulsions in electron accelerator experiments is discussed. The proposed method has been used for determination of the bremsstrahlung energy spectrum from a synchrotron target and for investigation of positron annihilation in flight. A.

LIST OF JOURNALS

The following list supplements the Lists of Journals published with the January number of Volume 56 (1953), and the Supplements published with the Indexes to Volumes 56 (1953), 57 (1954), 58 (1955) and 59 (1956). Copies of the numbers containing these lists can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Avtomat. i Telemekh.	Avtomatika i Telemekhanika. [Abstracted by the Electrical Research Association.]
Bundesbahn	Die Bundesbahn. [Abstracted by Railway Engineering Abstracts.]
Fizika Metallov i Metallovedenie	Fizika Metallov i Metallovedenie. Izdatel'stvo Akademii Nauk SSSR, Sverdlovsk.
Forschungsber. Wirtsch. - Verkehrsmin. Nordrhein-Westfalen	Forschungsberichte des Wirtschafts- und Verkehrsministeriums Nordrhein-Westfalen. Westdeutscher Verlag, Ophovener Strasse 1-3, (22a) Opladen/Rhld.
Ljuskultur	Ljuskultur. Formerly: Tidskrift för Ljuskultur [T. Ljuskultur].
Radiotekhnika i Elektronika	Radiotekhnika i Elektronika. Akademii Nauk SSSR, Cherkasski per., 2, Moscow.
Rev. gén. Chem. de Fer	Revue Générale des Chemins de Fer. [Abstracted by Railway Engineering Abstracts.]
Rly Gaz. (London)	Railway Gazette. [Abstracted by Railway Engineering Abstracts.]
Rly Locos and Cars	Railway Locomotives and Cars. [Abstracted by Railway Engineering Abstracts.]
T. Ljuskultur	Tidskrift för Ljuskultur. Title changed to: Ljuskultur (from Vol. 29, No. 1, Jan.-March, 1957).
Times Rev. Industr.	Times Review of Industry. [Abstracted by Railway Engineering Abstracts.]

ERRATA

Author Index (1956) page 1058, column 2 : under Grümm,H. for "2770" read "3770".
Author Index (1956) page 1091, column 2 : for "Mentner,J.W." read "Menter,J.W.".
Abstr. 2340 (1957) last line : this should read "a maximum of 0.5% at 2000 volts for carbon and of 2.5% at 1000 volts for iron".
Abstr. 2444 (1957) line 2 : for "L.I.Deryugin" read "L.N.Deryugin".
Abstr. 2683 (1957) line 2 : for "L.M.Ledermann" read "L.M.Lederman".
Abstr. 2855 (1957) line 10 : should read "$T = 0.773 + 0.750d + 0.463d^2 - 0.1148d^3 + 0.007\,08d$".
Abstr. 3047 (1957) line 6 : for "Narvier-Stokes" read "Navier-Stokes".
Abstr. 3687 (1957) line 1 : for "BULDUP" read "BUILDUP".
Abstr. 3948 (1957) line 3 : for "Swedish" read "Russian".

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